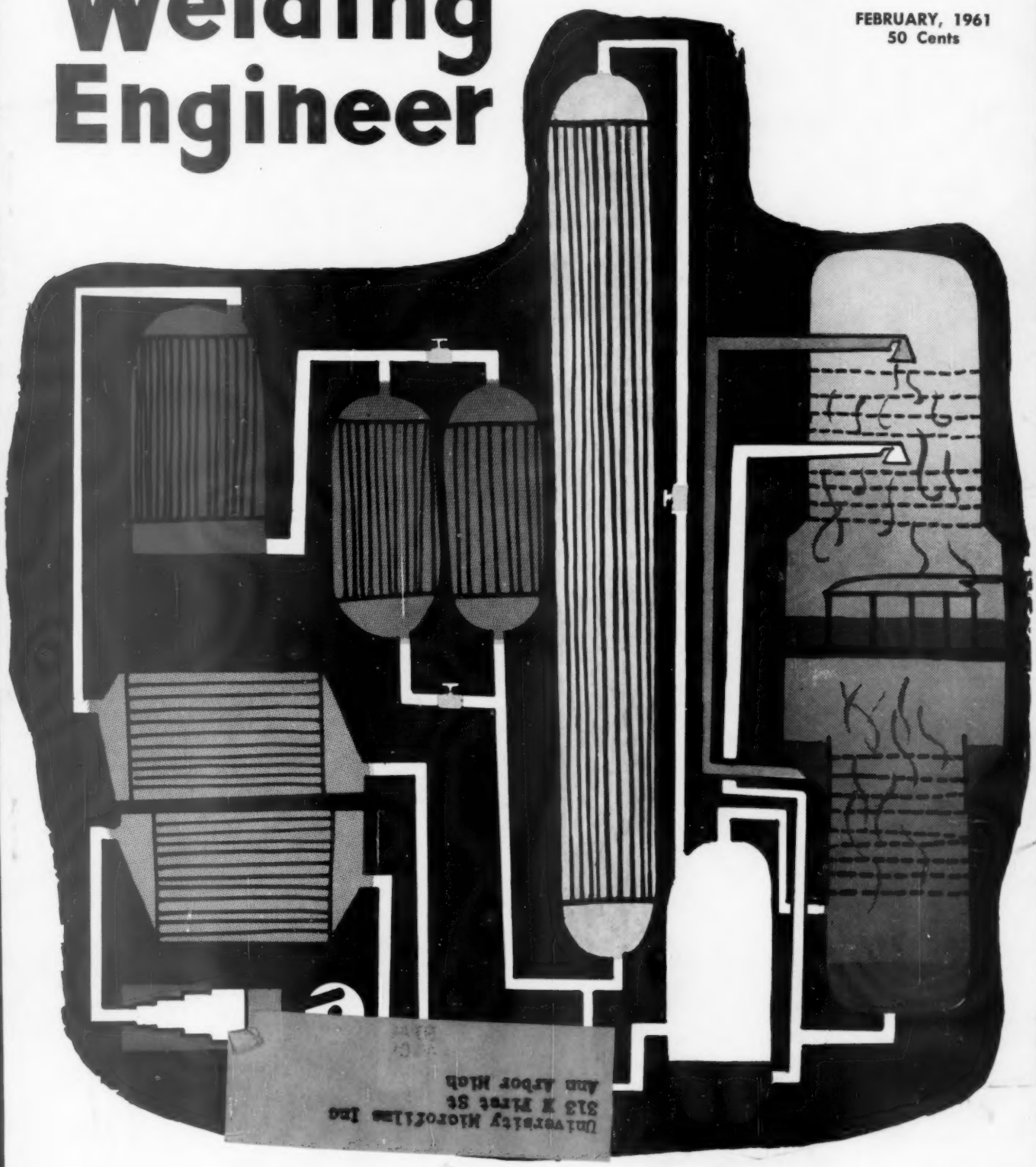
Welding Engineer

FEBRUARY, 1961
50 Cents



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In this issue: ***Oxygen production, distribution, uses***

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It is little wonder that the Hobart motor generator remains so popular! When you're in the market for a dependable DC welder, remember this "best-seller."

HOBART WELDERS • ELECTRODES

Write for bulletin DM-101. Hobart Brothers Company, Box U-21, Troy, Ohio.

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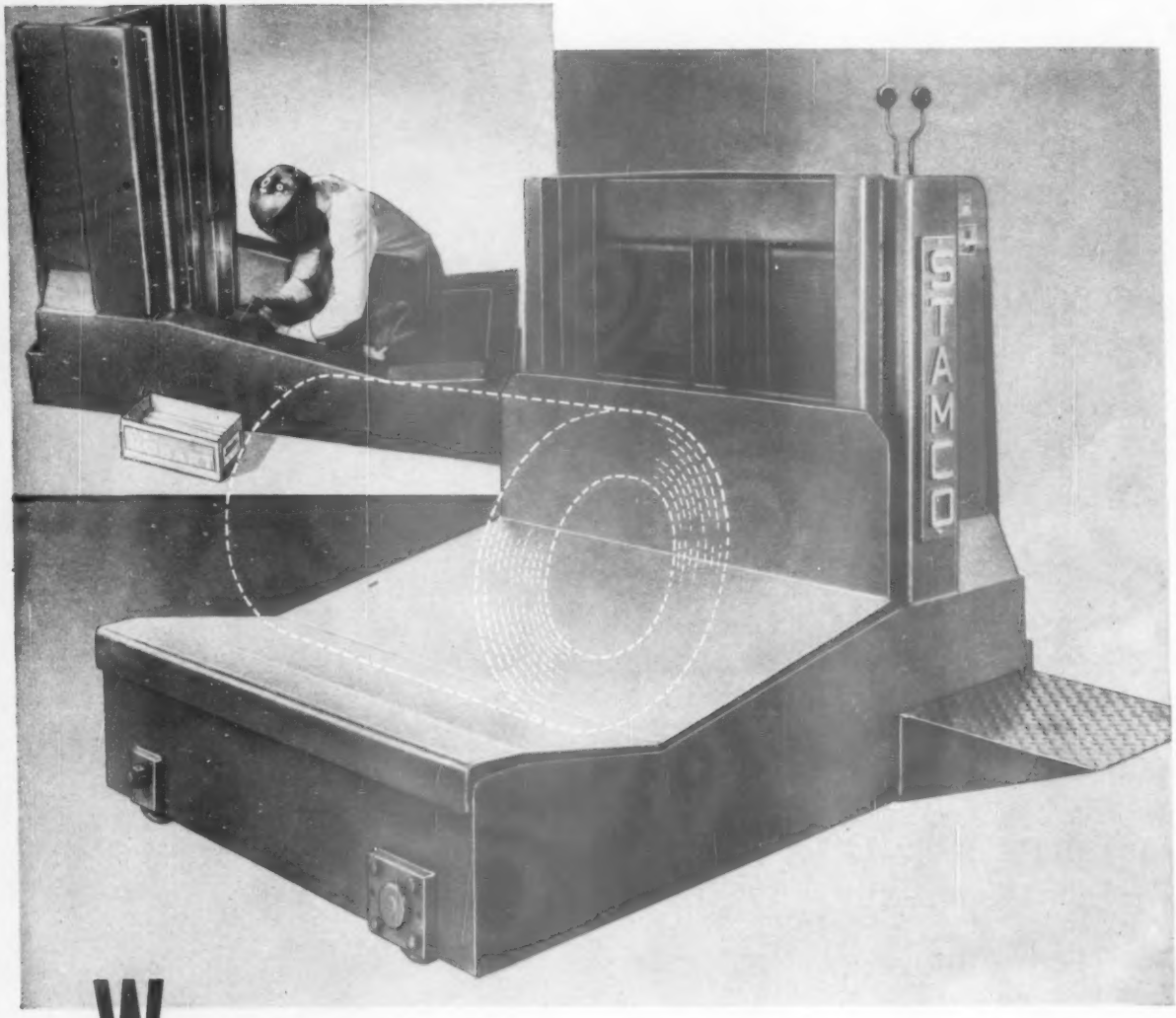

WHEN A PRODUCT MUST COMBINE... STRENGTH AND LIGHT WEIGHT... USE HOBART ROCKET 24 ELECTRODES

To handle 5,000 to 20,000 pound coils of steel, floor-type coil cars manufactured by Stamco, New Bremen, Ohio, must be rugged, yet light weight for good maneuverability.

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You too can build strength, dependability and low cost into your product—specify and use Hobart Rocket 24 Electrodes.

Hobart Brothers Company, Box U-211, Troy, Ohio

HOBART WELDERS · ELECTRODES

VOL. 46—No. 2

Welding Engineer

The magazine of joining and severing of materials

This is welding: February, 1961

Cover . . . an original stylized drawing of an oxygen liquefaction plant by Don T. Jefferson, WE's promotion manager.

Oxygen — its production, distribution and uses 25

Although the most abundant element, oxygen was not available in large enough quantities for commercial use until isolated from water and air. Today most oxygen is liquefied, as described in this article.

Economical oxygen distribution, storage is a must 28

The final price of any product must include the cost of getting it there and keeping it there. This distribution and storage problem, coupled with rising demands for high-purity oxygen, have led producers to build new plants and expand existing facilities as reported by **Gregory Cannizzo.**

Industry consumes over 50 billion cu ft of high-purity oxygen 32

Many different industries use high-purity oxygen, but more than half of the total amount produced in a given year goes to the steel industry. And the trend for oxygen use in steel making is still upward.

What you should know about oxygen regulators 34

Just as important as production, distribution and storage of oxygen is the device which makes control of high-pressure oxygen a possibility — the pressure reducing regulator. Author **Harris A. Goodwin** details its components, production and uses.

★(For a reprint of this article, circle number 250.)

Nickel steels, aluminum compete in cryogenic market 38

Battle lines are being drawn by metal producers to get their share of the growing market for containers to store and ship liquid oxygen and other liquefied gases, as reported by **F. T. Tancula.**

Also in this issue:

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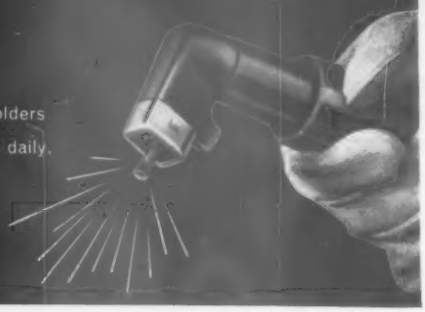

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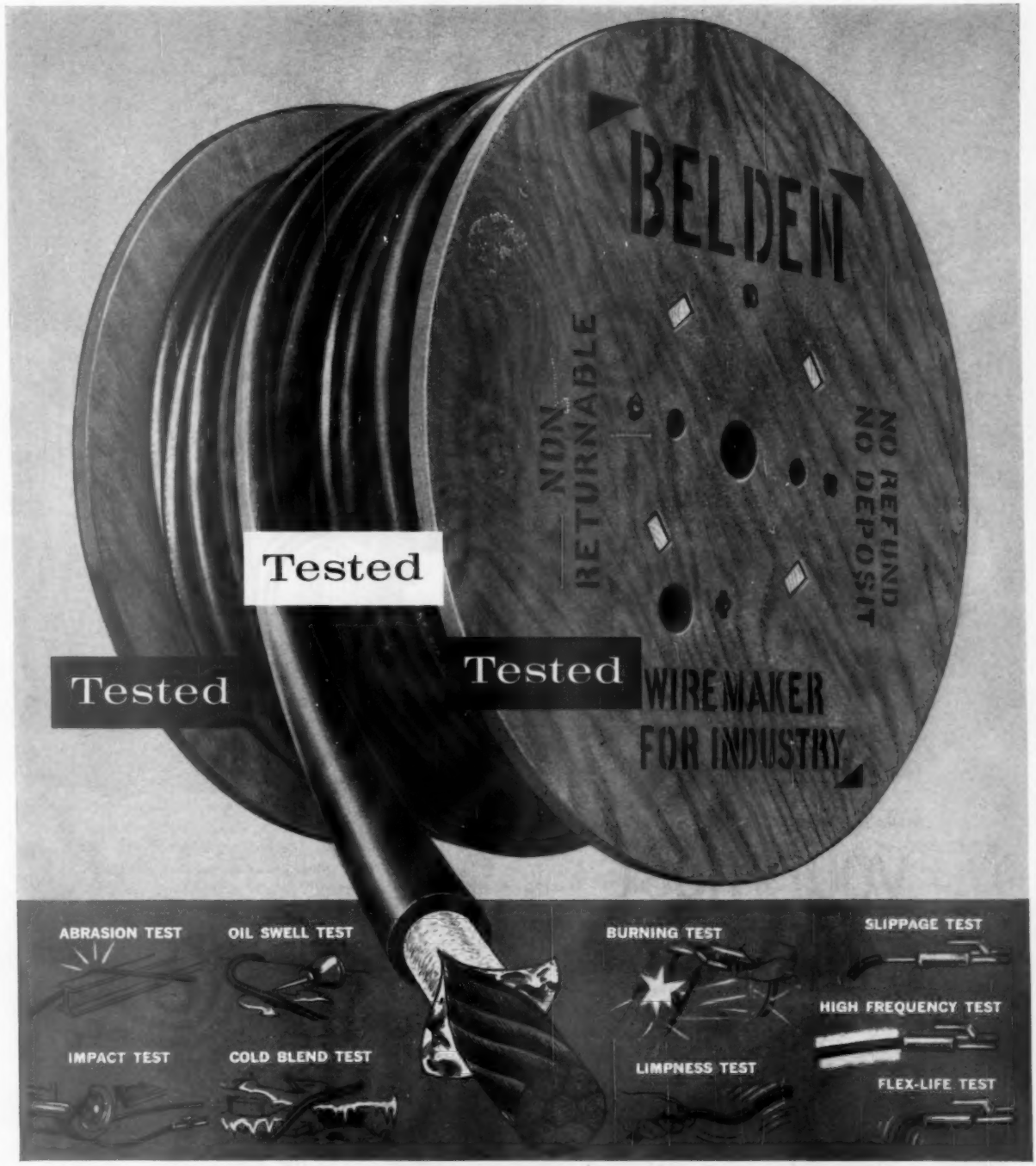

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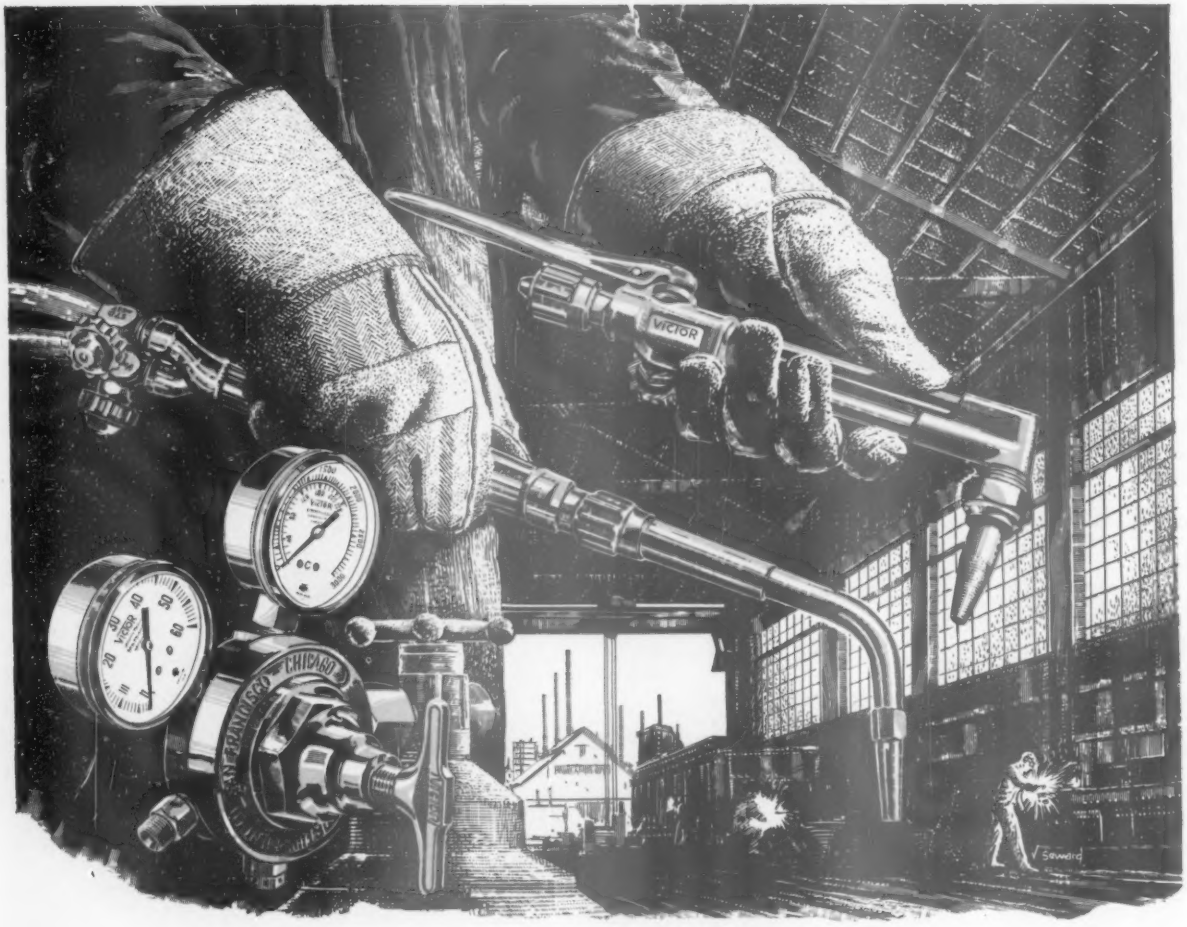

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SKETCH of proposed new plant of The Crescent Co. and its Carol Cable Div., Pawtucket, R.I., is examined by former Chamber of Commerce President Frederick R. Glassman (seated left) and Crescent President John M. Sapinsley (seated right). Standing (from left) are Raymond E. Borden, Rhode Island Development Council; George R. Bennett, chamber of commerce; Gerald A. Oster, Lincoln town administrator; L. Philip Lemieux, BVG&E industrial developer; Fred L. Hansen, development council; and Milton Sapinsley, Crescent Co. board chairman.

Crescent purchases site for wire, cable plant

By purchasing a 38-acre tract in nearby Lincoln, the Crescent Co., Inc., Pawtucket, R. I., and its Carol Cable Div. moved toward construction of a 250,000-sq-ft modern one-story plant for producing insulated wire and cable.

The building site, acquired in cooperation with the Rhode Island State Development Council and the Lincoln Industrial Commission, is located on George Washington Highway.

Crescent officials emphasized that the firm is not vacating its present quarters.

According to President John M. Sapinsley, the design of the new plant provides for expansion in the future without disturbing production. The new plant, when completed, will insure more efficient and more economical manufacturing operations than is possible in the company's present Pawtucket plant.

He added that the company has embarked on a six-year expansion program. In addition to the new plant, the firm is developing new products and has expanded its management personnel. (See *VIPs in review, this issue.*)

Airco holds school for field personnel

A welding school designed as a training program for salesmen and technical representatives is being conducted by Air Reduction Sales Co. at its electrode and wire manufacturing plant in Sparrows Point, Md.

Competitive, as well as Airco-manufactured, electrodes are studied at the school which is run on a twice-a-month basis with one-week courses. Classes, which begin at 8 a.m. and last till 4 p.m., are limited to six Airco personnel per session.

STUDENTS at Airco's electrode welding school follow up blackboard sessions with practical welding exercises on electrodes being studied while instructors watch their progress.

February's Headlines

Wichita welding show to feature exhibits

Fifteen or more major manufacturers will exhibit their latest products and equipment at the AWS Wichita Section's Mid Western Welding Show on March 24 and 25.

The show, which will include live demonstrations, will take place in the National Guard Armory at 3617 S. Seneca in Wichita.

AWS revises book of welding terms

AWS has prepared a revision of Standard Welding Terms and Their Definitions.

This first revision in 12 years was prepared in conjunction with a new Master Chart of Welding Processes. Both book and chart can be obtained for $2 from American Welding Society, Dept. T, 33 W. 39th St., New York 18, N. Y. The book alone is $1.50; the chart is $.50.

ASM buries welded time capsule

An American Society for Metals welded time capsule, presented by A. O. Smith Corp., Milwaukee, was buried recently at ASM national headquarters, Metals Park, Ohio.

The copper-aluminum capsule containing documentation of metallurgical progress is buried alongside a separately enclosed quantity of uranium.

AWS sells almost all exposition space

Practically 90% of all available space has been sold for the AWS Annual Welding Exposition to be held April 18-20 in the New York City Coliseum.

With only manufacturers of welding equipment and related materials permitted to exhibit, the show is one of the most highly specialized in the United States.

British to exhibit new oxypropane cutter

A new oxypropane cutter, made by British Industrial Gases, Ltd., England, will be demonstrated at the 1961 Engineering, Marine, Welding and Nuclear Energy Exhibition in London, April 20 to May 4.

The cutter system known as Cutomation, has a new type of nozzle with a convergent/divergent interior diamond-honed to 0.001-in. tolerance. The nozzle insures that mixed gases emerge at high speeds free from turbulence to form a narrow cutting stream of constant width.

200 exhibits highlight Western Metal Congress

More than 200 exhibiting firms and 32 technical sessions will be featured at the 12th Western Metal Congress and Exposition on March 20-24 in Los Angeles.

An array of exhibits to introduce new metalworking ideas and developments will be staged in Pan-Pacific Auditorium and its adjacent pavilion. Technical sessions in Ambassador Hotel will be presented by the sponsoring American Society for Metals and six other prominent engineering organizations, including AWS.

HAMMER Blow Tool Co., Wausau, Wis., recently completed this new office building adjacent to their manufacturing facilities. The new building has a total floor space of 6,000 sq ft.

A 10-PLY laminate of "Pluton" heat resistant fiber, reinforced with a high-temperature phenolic resin, withstands heat of 5,000 F without making it necessary for this man to withdraw his fingers, just 3 in. from the "hot spot."

Heat-resistant fiber won't char or melt

An all-organic heat-resistant fiber which retains its flexibility and part of its strength after exposure to intense heat is now available from Minnesota Mining and Manufacturing Co., St. Paul.

The fiber has been exposed in a plasma jet to temperatures up to 18,000 F without melting. In addition, a 1-lb molten-steel slug, heated to 3,000 F, has been poured on an unsupported 1-psy sample of the fabric stretched across a frame. The molten steel solidified without burning through the fabric.

Potential uses for the new fabric include anti-arc wraps in electrical power plants and lightweight fire-protective curtains. In the form of a laminate, the fiber is also suitable for structural parts.

Sonobond opens demonstration site

Sonobond Corp., subsidiary of Aeroprojects Inc., West Chester, Pa., has opened a new sales-demonstration headquarters at 202 E. Market.

The facility has a selection of standard equipment so customers may be shown the types of equipment available and what can be done with them.

Nondestructive testing symposium scheduled

The second annual symposium on nondestructive testing of aircraft and missile components will be held on February 14-16 at Gunter Hotel, San Antonio, Tex.

The symposium is being sponsored by the South Texas Section of The Society for Nondestructive Testing, Inc., and Southwest Research Institute.

COMING EVENTS

FEB. 9-11: National Ornamental Iron Mfg. Association Convention, Dinkler-Tutwiler Hotel, Birmingham, Ala.

FEB. 14-16: 2nd Annual Symposium on Nondestructive Testing of Aircraft and Missile Components, Gunter Hotel, San Antonio, Tex.

MAR. 20-24, 1961: 12th Western Metal Congress, America Society of Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

MAR. 23-25: 37th Spring Meeting, American Machine Tool Distributors Association, Mark Hopkins Hotel, San Francisco.

MAR. 24-25, 1961: Welding Show & Exhibit, Wichita Section AWS, Kansas National Guard Armory, Wichita, Kans.

APRIL 6: 4th Annual Distribution Conference, Pennsylvania Gas Association, Tally Ho Inn, Valley Forge, Pa.

APRIL 10-15: International Institute of Welding Meeting, Sheraton-Atlantic Hotel, New York City.

APRIL 17-21: 42nd Annual Convention, AWS, Commodore Hotel, New York City.

APRIL 18-20: AWS Annual Welding Exposition, Coliseum, New York City.

APRIL 24-25: IAA Annual Meeting, Boston.

MAY 8-10: 17th Annual Convention, NWSA, Hotel Commodore, New York City.

MAY 22-25: The Design Engineering Show, Cobo Hall, Detroit.

U.S. Steel opens new weld pipe mill

A modern, continuous weld pipe mill began production recently at the Lorain, Ohio, works of United States Steel's National Tube Div.

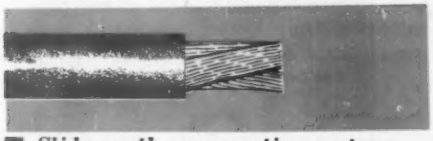
Over 2½ years under construction, the mill will produce pipe in diameters ranging from 1¼ in. to 4 in. Capacity of the mill will be 237,000 tons of pipe annually.

(More news on page 66)

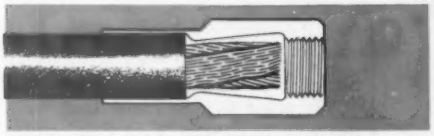
Jackson Sealed Tight Holders

for trouble-free connections

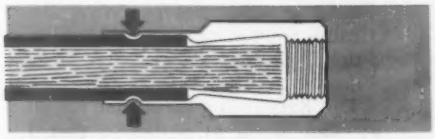
■ *Strip back the cable jacket–*



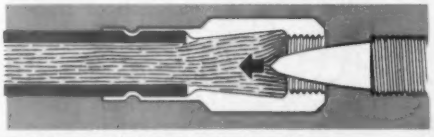
■ *Slide on the connection nut–*



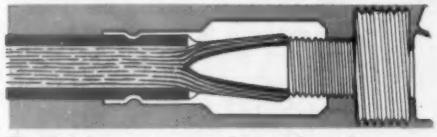
■ *Seal nut with crimping tool–*



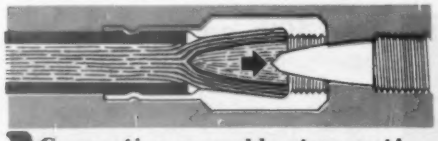
■ *Push holder stud into strands–*



■ *Wrench tightly into place–*



■ *Holder end may be replaced–*

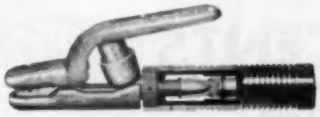


■ *Connection assembly stays put!*

These copper alloy quality Jackson electrode holders have a permanent-type cable connection device good for the life of the cable. It grips the cable jacket as well as the cable, sealing out moisture and dirt. The jacket can't slip back, the strands won't flex and break. The 'stinger end' of the holder can be replaced repeatedly without remaking the connection.

These ST holders are attached to the cable in a simple mechanical way, but the result is an almost fused connection having excellent conductivity.

Get the utmost in conductivity, ease of connection, and long life. Get lower holder costs when buying ST holder stinger end replacements. Get a Jackson Sealed Tight holder in your hands soon and you'll *see* why they're better.



Model ST-3, copper alloy holder for electrodes through ¼" dia. Rated for 300 amps.

Model ST-5 copper alloy holder for electrodes through ⅜" dia. Rated for 500 amps.

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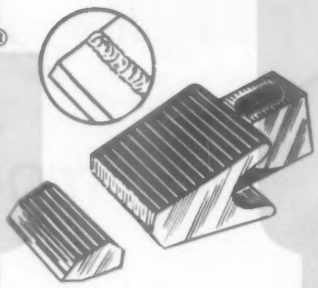

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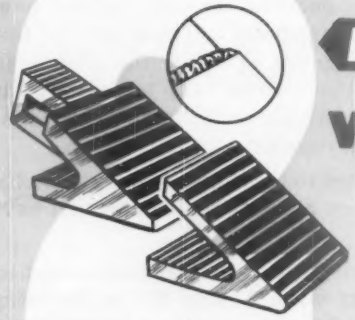

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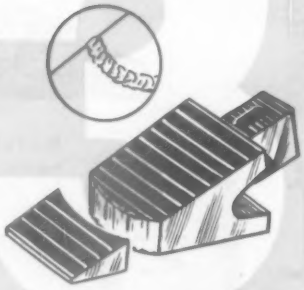

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Letters...

Welding's future

Sir: *Winnipeg, Canada*

In regard to predictions for the future, it is safe to predict that in the decades to come welding will be used more widely in the manufacture of more products by more manufacturers in more different ways than now seems possible to even the most enthusiastic proponents of the process.

In a virtually unbounded range of applications, its cost-cutting and time-saving advantages, its versatility and in the vast opportunities for product improvement offered by designing for its use, this is indeed just the beginning for welding.

The opportunities are limitless not only in the production of civilian goods but also in the vitally-important area of western defense, space exploration, and atomic power. Only by welding could many of the advances in the latter fields have been made.

N. W. Dorosh
Editor
Canadian Welder

Fact File

Sir: *Albuquerque, N. M.*

We want you to know that we use your Mid-June "Fact File" and product reference issue more and more as time goes by. Why? Because we can quickly find top articles, product classification, trade names, and names and addresses. This has saved a lot of time for us.

One thing in particular that I wish to commend your organization for is the inclusion of trade names of lesser known brands — people who do not advertise very often — in your "Fact File." Those concerns should be eternally grateful to WELDING ENGINEER for these listings.

Thank you for making the "Fact File" available to us without additional cost, since it is a part of our regular subscription.

Lowrey L. Stewart
Valley Welders Supply Co.

50th anniversary

Sir: *Northville, Mich.*

Mention of my 50th year in the resistance welding field on page 7 of the December issue is much appreciated by me. It brings to mind

a request made by your editor of many years ago that I write a feature article on welding for the first anniversary number of your magazine. (*Editor's note: Mr. Hackett wrote the lead article in the January, 1917, issue of* WE *on the subject of electric spot welding.*)

It was an experience that I thoroughly enjoyed. Over the years, your progress has been carefully watched. My best wishes for increased activity and progress in a field that has witnessed some fascinating developments. In these, your publication has played an important role.

An interesting item in your "Letters" section catches my eye. The interest of Mr. Charles E. Squibb is timely.

Reader Hackett at the controls . . .

The above photo was taken at the Henry Ford Museum in Greenfield Village on Nov. 11 when some of the AWS national officials, Ford Motor Co. and Progressive Welder & Machine Co. officials assembled to witness my demonstration of a replica of the original resistance welder made by Professor Elihu Thomson about 75 years ago.

On the evening of Oct. 16, 1936, I presented a program in Detroit to celebrate the 50th anniversary of this invention. The Franklin Institute of Philadelphia loaned me the original to display at this meeting. They also allowed me to arrange with Mr. Henry Ford to have the replica made in the Menlo Park section of the village. It has been on display in the museum since and has been seen by thousands of visitors.

Because of my own interest in this item, it has been possible for me to use it in numerous public appearances where I have addressed engineering groups on the history and development of the resistance welding industry. If perchance Mr. Squibb is interested, it is entirely possible it could be brought to Dallas for such a meeting.

Albert E. Hackett
Sales Engineer
Progressive Welder & Machine Co.

Brazing rods

to meet AWS-ASTM specifications

AMPCO-BRāZ®

Produced from start to finish by one reliable company

Packaged for easy handling and stocking

AMPCO-BRāZ No. 1
(AWS specifications, RB Cu Zn-D)

Low-fuming, high-strength, high nickel rod for joining and overlay with the oxy-acetylene process. Bonds readily to copper-, iron-, and nickel-base metals and alloys.

AMPCO-BRāZ No. 4
(AWS specifications, R Cu Zn-B)

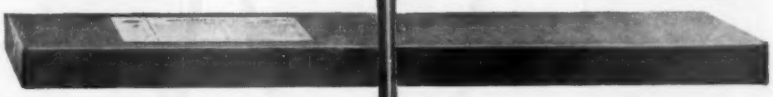
Low-fuming, manganese bronze rod with nickel added for higher strength and ductility. For brazing and braze-welding high-strength bronzes and brasses, steel, cast iron, and malleable iron with the oxy-acetylene process.

AMPCO-BRāZ No. 2
(AWS specifications, R Cu Zn-C)

Low-fuming, high-strength, manganese bronze rod for brazing and braze-welding steel, cast iron, malleable iron, and copper and its alloys with the oxy-acetylene process.

AMPCO-BRāZ FLUX No. 2

Saves time on general welding, cast-iron welding, and brazing. Has many other advantages.



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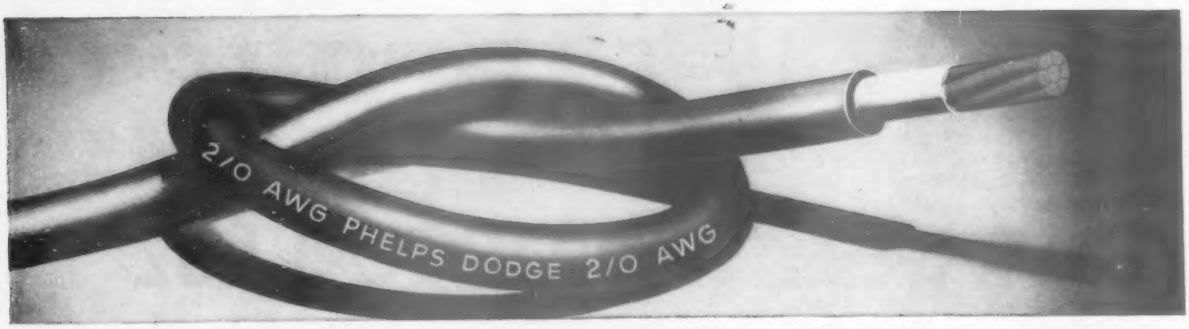
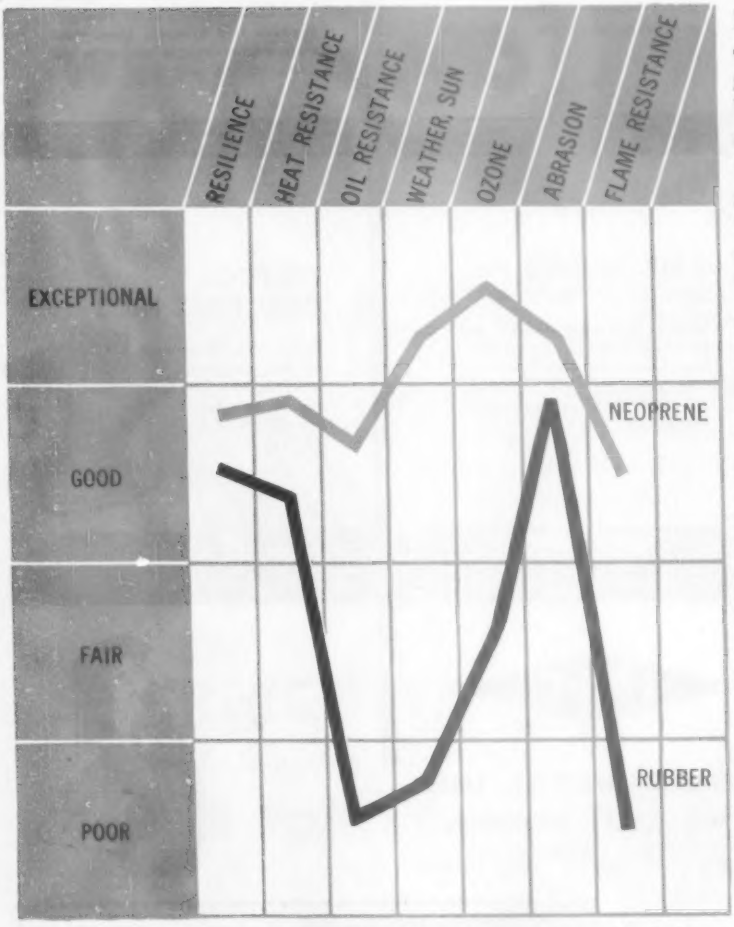


HERE'S PROOF THAT **PHELPS DODGE HABIRPRENE** (NEOPRENE) **ARC WELDING CABLE** IS STRONGER, LASTS LONGER!



(Adapted from chart of Elastomer Chemical Dept., E. I. du Pont de Nemours & Co., Inc.)

Phelps Dodge Habirprene arc welding cable combines maximum flexibility with the greatest resistance to deterioration caused by exposure to harmful physical, chemical and mechanical conditions. The ability of Habirprene welding cable to withstand greater overall wear and tear, as compared to rubber welding cable, is shown in this chart compiled from comparison tables of four rubber goods manufacturers.

Phelps Dodge pioneered the fabrication of Habirprene welding cable, the first real advance in this field, more than 10 years ago. Records show that Habirprene cable lasts much longer than rubber cable and—in some applications—as much as *four times longer!* Although the initial cost of Habirprene is slightly higher, it will more than repay you in long-time service. Habirprene arc welding cable meets full requirements of A. S. T. M. D752.

See your authorized Phelps Dodge distributor for Habirprene arc welding cable with the indelible gold markings—the sign of higher quality, longer-lasting cable.

Phelps Dodge also makes a full line of rubber arc welding cable and welding power supply cable. All the above cables are available from stock.

PHELPS DODGE COPPER PRODUCTS

CORPORATION

OFFICES IN PRINCIPAL CITIES

45th anniversary

CONGRATULATIONS ON *WE*'s 45TH ANNIVERSARY. YOU HAVE CONTRIBUTED MUCH TO THE WELDING INDUSTRY.

Ray L. Townsend
Tweco Products, Inc.

Non-destructive testing

Sir: *Seattle, Wash.*

Your June, 1960, issue has just come to my attention. Congratulations on a very fine job covering non-destructive testing. Your coverage was so complete that we feel left out.

On page 72 you give a "Complete list of manufacturers of non-destructive testing equipment and services." Industrial X-Ray Engineers manufacture a complete line of portable x-ray equipment designed for industrial radiography in the field, particularly of welding. While this equipment is not available for sale, it is available for lease. Perhaps more of our equipment is in use in the examination of field welding than any other equipment.

Our service organization also provides a complete field radiography service having operating bases in Franklin Park, Ill.; Houston; Woodbridge, N. J.; Oakland, Cal.; Portland, Ore.; and Seattle. Our Canadian affiliate, Industrial X-Ray, Ltd., is based at Edmonton, Alberta. Our Portland and Seattle laboratories offer a complete non-destructive testing service.

Harold Howland
Vice President
Industrial X-Ray Engineers

(*We have added Industrial X-Ray Engineers to our Mid-June FACT FILE issue from which we took the June listings. — Ed*)

Ambridge's riveting

Sir: *Ambridge, Pa.*

. . . It is interesting to note your comments in the November issue (*AWS keynoter warns of complacency, p.* 64) relative to the tour of our Ambridge Plant, that many who took part in the tour expressed chagrin over the fact that most of the fabrication witnessed was riveted. Possibly such a tour as this is good to stimulate an interest in welding. American Bridge Division will fabricate what is designed and frequently we do not have control over the mode of fabrication covered by the design.

P. E. Masters
Welding Engineer
American Bridge Division

KEEP JOINT-WEAKENING, GAS-WASTING ACETONE OUT OF THE FLAME

...with a REGO®

job-tailored gas manifold

Without even realizing it, you may be discharging your acetylene cylinders too fast causing troublesome *acetone* carry-over into the flame! Acetone lowers flame temperature, increases gas consumption and worst of all, affects the quality of the joint. Your best protection against acetone carry-over is a properly designed RegO manifold for *controlled automatic* discharging of acetylene cylinders. And, RegO manifolds save manpower by reducing individual tank handling, conserve space, assure *complete* emptying of tanks, lower maintenance costs.

THIS BOOKLET EXPLAINS MANIFOLDS, HELPS YOU DESIGN YOUR OWN SYSTEM

RegO Manifold Reference and Planning Brochure explains how manifolds work, lists various types and typical combinations. Simplified, exclusive RegO code system shows how to plan your own manifold system according to your particular needs.

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Please send me a free copy of your helpful Manifold Reference and Planning Brochure G-300/GD.

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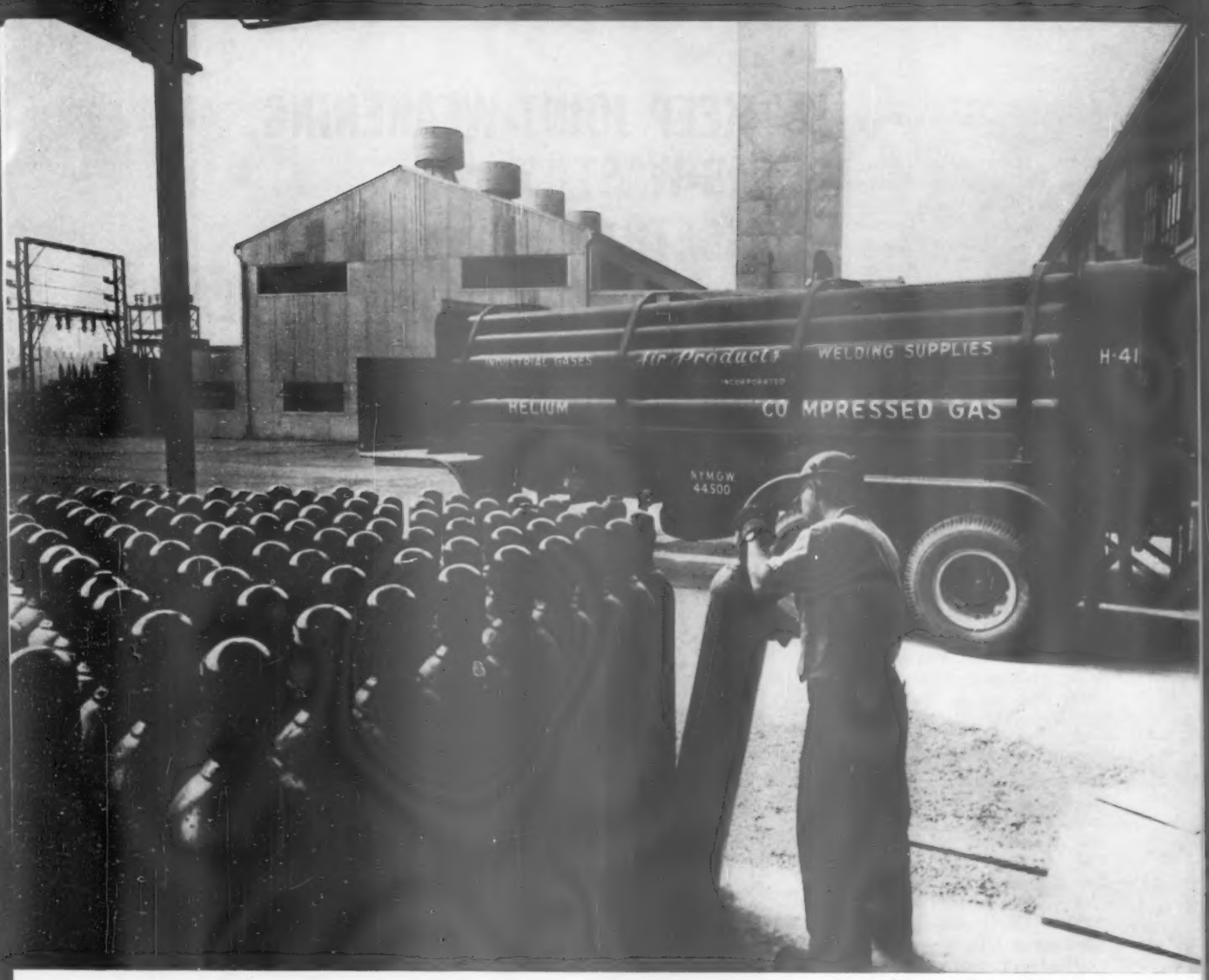
For more facts Circle No. 159 on Reader Service Card



Air Products Inc., one of America's leading manufacturers of industrial gases and producers of cutting and welding equipment, uses Taylor-Wharton Gas Transports as part of their industrial gas distribution system.

And no wonder.

Low initial cost, extreme mobility and economical storage make Taylor-Wharton Gas Transports ideal for the bulk transportation of compressed gases as well as for semi-permanent storage.

Many other of the nation's gas producing, oil refining, petrochemical, food and electronic companies now employ flexible, mobile gas transports.

Why don't you? Write to:

More than a Century in Harrisburg 8, Pa.

HARRISBURG STEEL CO.

Division of HARSCO CORPORATION

WELDING ENGINEER

Your February, 1961

Weld World

As WE went to press, these were the industry's latest developments:

. . Automatic Welding Co., Waukesha, Wis., manufacturer of automatic welding equipment, has been acquired by The McKay Co., Pittsburgh, electrode manufacturer. Automatic will be operated as a wholly-owned subsidiary, with its founders, I. R. Bartter and E. L. Mattson, remaining in their capacities as president and vice president, respectively.

. . A general reduction in the prices of its welding machines, electrodes and supplies was announced by The Lincoln Electric Co., Cleveland. Individual reductions range up to 12.5%. According to the firm, the action is aimed at helping "users of arc welding equipment meet the challenges of competition and rising costs."

. . Tubular stainless steel composite wires have been added to Stoody Co.'s product line-up. Close control of wire alloy content is possible through tubular fabricating method, the same method used by the Whittier, Calif., firm to produce its hardfacing alloy wire line. All stainless wire conforms to ASTM and AWS standards.

. . Non-destructive testing equipment sales will continue to expand sharply in 1961 for products that require tight quality control, but volume sales for testing mass production will rise only in proportion to practical money-saving applications discovered. This is the prediction of John Reynolds, technical director for Picker X-Ray Corp., White Plains, N. Y.

. . Special coating on metal surface is key to new technique for joining copper devised by Chase Brass & Copper Co., Waterbury, Conn., subsidiary of Kennecott Copper Corp. Several types of bonds are possible: complete diffusion, braze, and combination diffusion and braze. See details on page 46.

. . Arc portable spot welders will be warehoused, sold and serviced by new firm, Arc Spot Welder Corp. Active management of the corporation, located at 66-10 Woodside Ave., New York City, goes to Vice Presidents Max Osborn and Frank Furth.

. . Electrical conditions in an a-c welding arc can be measured by a new meter recently introduced in England. Unit consists of a watt-hour meter, ammeter, voltmeter, and protective relay — all housed in single compact case. User can see at a glance arc voltage, current and total energy consumed.

. . Same British firm has introduced an electrode for applying rapid and concentrated heat to metal workpiece before welding, bending or straightening. This localized heat-treat unit can be applied in any position and on either a-c or d-c. Prime advantage: application to relatively inaccessible areas where torches or other heat devices cannot reach.

now available . . .

the 14th edition of

The WELDING ENCYCLOPEDIA

For forty years, the Welding Encyclopedia has been the standard guide for welding information and welding know-how all over the world. The 14th Edition updates the previous listings, and includes the latest in processes and other important data. Fifty percent of the material in the Fourteenth Edition is new.

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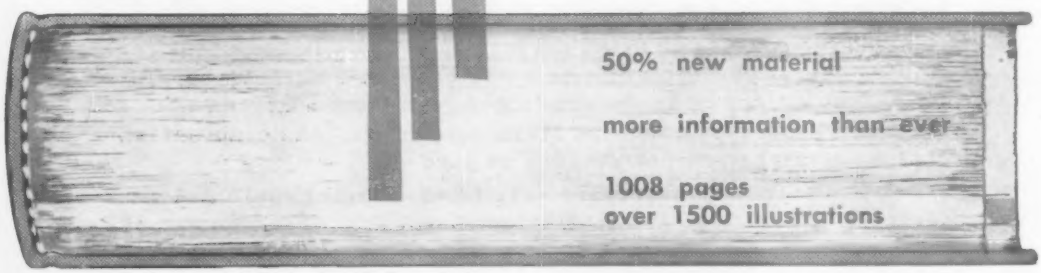

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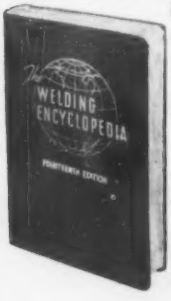

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☐ I am enclosing my check or money order for $7.50 for each Encyclopedia ordered.

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Between passes

700-year-old welds

Wrought iron beams, made in the 13th century from short lengths of iron welded together, attracted the interest of an American steel industry delegation in India last year. The members considered the beams in the Temple at Kanarak to be one of India's wonders, along with the 1,500-year-old wrought iron pillar at Delhi.

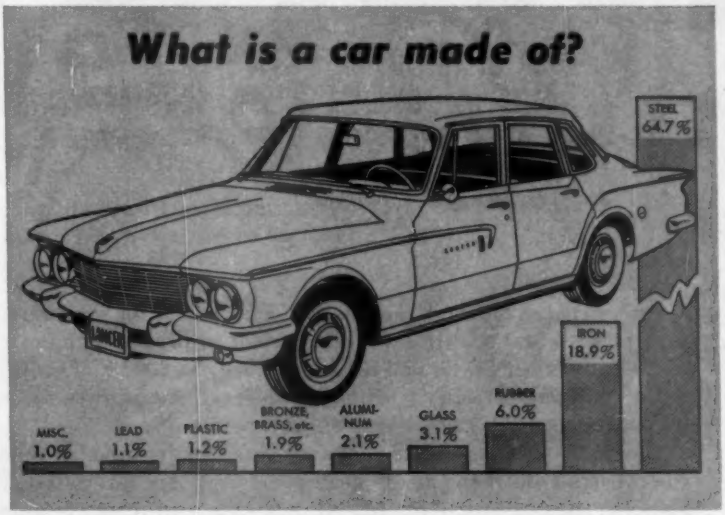
The beams consist of 3-in. blocks of iron welded together. They are about 10 in. square and up to 20 ft long. These beams support the flat stone roof of the "Black Pagoda" located near the Bay of Bengal, about 275 miles southwest of Calcutta. This is not far from the modern steel plant at Rourkela.

prize welding film

An industrial movie entitled "Welding aluminum — different, not difficult" was awarded the Antwerp Film Festival's highest motion picture honor, the Diplome De Merite Exceptionnel. Separate awards went to Reynolds Metals Co., Richmond, Va., the film's sponsor, and Vogue Film Productions, Louisville, Ky., which produced it.

The 1960 Belgian industrial film competition included 450 movies from 30 countries.

"Welding aluminum. . ." is a 16mm full-color film that runs a little over 33 minutes. It is available for viewing by audiences interested in aluminum fabrication and welding. Write George Birdsall, Director of Editorial Services, Reynolds Metals Co., Richmond, Va.



STEEL is still the major material in the modern car, accounting for almost two-thirds of the weight. The percentage of other materials used in this typical compact, a Dodge Lancer, are shown in the drawing above.

Words worth quoting

"Those who believe in expanding governmentalism and in central planning of America's economic destiny might label me as an 'apostle of the status quo,' to use one of their own terms. But there is nothing static, nothing 'old hat,' about free competitive enterprise. It is the reason we are where we are in this nation today. It represents our great hope of survival in a world threatened by the slow paralysis of thought and action which follows from economic myopia."

—Leslie B. Worthington, president, United States Steel Corp., addressing the annual meeting of the Television Bureau of Advertising, Inc., Nov. 18, 1960.

patent prose

In reporting its acquisition of a British patent on ultrasonic welding equipment, Aeroprojects, Inc., West Chester, Pa., gave excerpts of the language of the patent to show its contrast to the staid legal prose of United States' patents. Here is how the British patent begins:

"Elizabeth the Second by the Grace of God of the United Kingdom of Great Britain and Northern Ireland and of Her other Realms and Territories Queen, Head of the Commonwealth, Defender of the Faith: To all to whom these presents shall come greeting: Whereas Aeroprojects Incorporated a Pennsylvania Corporation . . . have prayed that a patent may be granted unto them . . . and whereas We, being willing to encourage all inventions which may be for the public good, are graciously pleased to condescend to their request. . ."

sans hoopla

In the publishing business, we are bombarded with bombast, flooded with fulsomeness, but often treated to trivia . . . so it is refreshing indeed to read a publicity release that does not make (mis) use of all the superlatives, nor lay (false) claim to any records. Such was the news release we received from the recently organized Fluid Power Society, Milwaukee. It began: "Though we cannot boast of an attendance that exceeded all expectations (about 50 were present), we can report . . . "

Ah, honesty!

55,000!

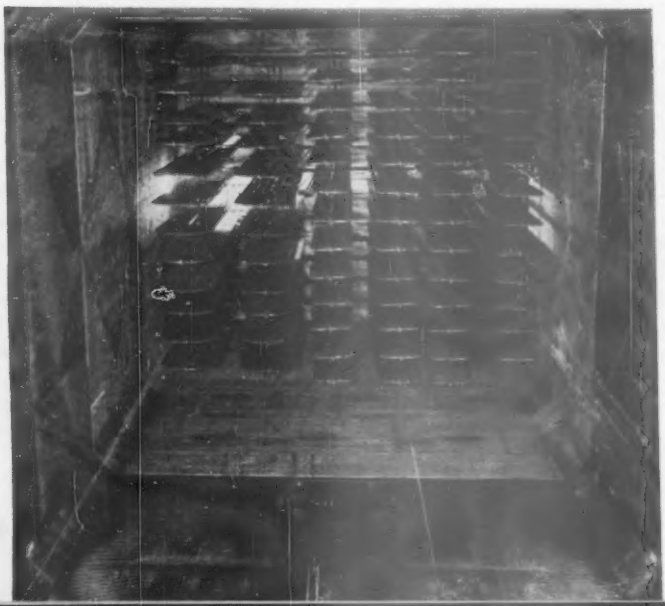
HIGH STANDARDS AND QUALITY ELECTRODES FEATURE CONSTRUCTION OF WORLD'S HIGHEST PRESSURE STEAM GENERATOR.

The Eddystone Station of the Philadelphia Electric Company is a milestone in power station engineering and operating efficiency.

Situated on the banks of the Delaware River south of Philadelphia, Eddystone is the first power station in the world designed to produce steam at the supercritical pressure of 5,000 pounds per sq. in. and a temperature of 1200° F. This breakthrough in the commercial generation of electricity is expected to set a new world's record for power station efficiency by producing a kilowatt hour from 2/3 pound of coal.

55,000 welds were used to fabricate the hundreds of miles of tubing and piping used in the construction of the steam generating unit. Approximately 25,000 of these were field welds made at the construction site. The extreme operating pressure and temperature necessarily required unusually high weld metal quality and reliability from the electrodes selected. For the field welds, Combustion Engineering, designer and manufacturer of Eddystone's No. 1 boiler, specified Arcaloy types 316 and 347 stainless steel electrodes for the chromium-nickel material, Atom·Arc 8018CM and 9018CM iron powder low hydrogen electrodes for the chrome-moly grades and Atom·Arc 7018Mo for the carbon-moly grades. Continuous visual inspection was conducted as all welding proceeded. Dye penetrant and X-ray inspection of welds were used throughout the erection of the boiler. When the boiler had been completely welded, it was hydrostatically tested at 8,000 psi. pressure. All of these tests and inspections failed to show one defective or leaking field weld.

These dynamic results mirror the experiences of many leading fabricators throughout the country. Like Combustion Engineering, they have proven conclusively that X-ray quality weld metal of Alloy Rods Company electrodes increases the efficiency of their welding operations. They have learned from experience—you can profit from their experience. Specifying your electrode requirements from our extensive line of quality alloy arc welding electrodes is the one sure guarantee of satisfaction. Alloy Rods Company, York 2, Pennsylvania.



The steam producing heart of the station is a C-E Sulzer Monotube Steam Generator, designed and manufactured by Combustion Engineering. This unit is 12 stories high, 100 feet across, and 75 feet from front to back. 170 miles of all-welded tubing and piping, low-chromium and chromium-nickel material, went into the unit's fabrication.

ALLOY RODS COMPANY

YORK, PENNSYLVANIA

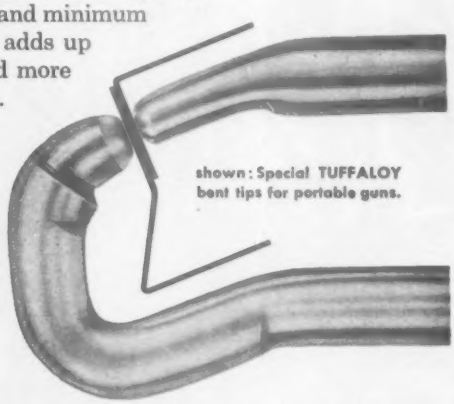
SALES OFFICES & WAREHOUSES; BOSTON, NEWARK, PHILADELPHIA, PITTSBURGH, BIRMINGHAM, CHICAGO, SAN FRANCISCO & EL SEGUNDO, CALIF.—DISTRIBUTORS IN ALL OTHER PRINCIPAL CITIES

TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES

For more facts Circle No. 161 on Reader Service Card

The Strongest Bent Tips Come From TUFFALOY

You get more spot welds for your money when you buy TUFFALOY bent tips. These electrodes are bent to precise angles so skillfully that there's no sacrifice of the wall strength needed to withstand heavy forging pressures. Examine a TUFFALOY bent-tip—the diameter remains constant and the coolant hole is unobstructed. So carefully is the job done that there's no cave-in at the outside of the bend, and minimum swelling at the sides. This adds up to longer electrode life, and more spot welds for your money.



shown: Special TUFFALOY bent tips for portable guns.

Doc Tuffy says . . . *All TUFFALOY tips keep their bright and shiny look. Oxidation is inhibited by dipping the parts in a passivation solution . . . another example of our attention-to-detail that spells extra value for you.*

Write or call your nearest AIRCO or TUFFALOY distributor for more information about TUFFALOY bent tips. Many styles are stocked as standard items, and special designs are quickly made to order. Be sure to ask for the TUFFALOY Catalog.

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In retrospect . . .

(Taken from **Welding Engineer** issues of February, 1916, 1931 and 1946)

—45 Years Ago—

Several concerns were represented at the recent Automobile Show in Chicago, among them being The Prest-O-Lite Co., Inc., Indianapolis; Imperial Welding Co., Chicago; Lincoln Electric Co., Cleveland; Westinghouse Electric & Mfg. Co., Pittsburgh; U. S. Gauge Co., New York City; and Turner Brass Co., Sycamore, Ill.

Manufacturers of welding rods, wires and fluxes seem to feel that prices are on the upgrade. One manufacturer of aluminum, for instance, states that no orders can be filled at this time . . . It would appear reasonable to expect that jobbers of supplies will be obliged to raise prices gradually, and if this is true, now is a good time to buy.

—30 Years Ago—

C. E. Phillips and Co., representing Stoody Co., Whittier, Calif., has announced the removal of their Chicago office and warehouse to 1929 W. 43rd St.

E. C. Turner of Air Reduction Co., New York City, was elected president of the Compressed Gas Manufacturers' Association last month. F. R. Fetherston was named secretary-treasurer.

—15 Years Ago—

E. A. Daniels and E. O. Williams have been elected vice presidents of Victor Equipment Co., San Francisco.

The corporate name of the Abrasive Co. of Philadelphia has been changed to the Simonds Abrasive Co. It is a division of the Simonds Saw and Steel Co.

To stimulate undergraduate interest in welding, A. F. Davis, vice president of The Lincoln Electric Co., Cleveland, has donated funds for undergraduate awards, which will consist of cash prizes presented annually to authors and publications for the best two articles on welding published in college undergraduate magazines or papers during the preceding year.

SIMPLIFY LOW-TEMPERATURE SILVER BRAZING WITH THESE SPECIALLY DEVELOPED FLUXES!

The correct selection of flux can offer unexpected help in speeding and simplifying production, minimizing rejects and lowering costs in low temperature silver brazing operations. The advantages to be gained by "selective fluxing" are *sufficiently important to warrant careful, thorough study!*

Silvaloy offers the most advanced flux developments in this specialized field. Here, is *a complete line of fluxes* . . . each providing outstanding performance, enabling you to select the correct flux for every possible low temperature brazing operation. The extra efficiency of Silvaloy "Selective Fluxing" is being proved daily on the brazing production lines of the country's leading manufacturers.

Call the Silvaloy distributor in your area for consultation and detailed information or, send for our booklet "A Complete Guide to Selective Fluxing for Low Temperature Silver Brazing."

Silvaloy fluxes are packaged in 65-lb. and 30-lb. drums, 5-lb. wide mouth jars (5 to a carton), 1-lb. and ½-lb. jars. The wide opening of the 5-lb. package makes it a most practical, time saving dispenser that also enables the operator to make use of every bit of flux in jar.

SEND FOR THIS COMPLETE GUIDE TO FLUXING

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MEET THE MILLER A-C "S" SERIES

A BEST BUY by ANY TEST

Compare! Comparison proves that amp for amp and dollar for dollar this is your best deal in a heavy duty a-c welder.

Low first cost teams up with maintenance-free reliability to make the "S" very big on value.

Yet everything needed for top performance is here, including movable coil design, silicon steel cores, class B insulated copper coils, superior cooling, and 80 volts open circuit for instantaneous arc starting. Case is heavy gauge steel under baked enamel lifetime finish with dead front construction.

Complete information on the 300 or 500 ampere Miller "S" a-c welders will be forwarded promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY • APPLETON • WISCONSIN

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FEBRUARY, 1961
OUR 45th ANNIVERSARY YEAR

Welding Engineer

ESTABLISHED 1916

Will we open the door?

DURING THE NEXT FOUR YEARS, two World's Fairs — Seattle in 1962 and New York in 1964 — will be held. Without a doubt, welding will play an important part in the preparation of the exhibit buildings and the theme structures at both.

The suggestion has been made that these huge expositions be used as springboards to better acquaint the general public with welding's role in our everyday lives.

Planning time is apparently too short for a proper exhibition at the Seattle World's Fair — but there is more than enough time to plan and develop a welding pavilion for the two-year exposition at New York.

Opportunity is knocking again — will we open the door?

Naturally, the project will be costly; it will require more imagination than generally has been shown in the welding industry. And it will require the cooperation of many related industries — welding equipment manufacturers, material producers and fabricators.

But the time and money spent would be well worth the effort considering the educational value received.

Not only would welding equipment be exhibited, but so would the products welding helped build. Consumers from every country would not only be told, they would be shown how welding makes their lives more pleasant and secure: through stronger, lighter, more pleasing and generally less costly products.

Will we take advantage of this opportunity to educate for welding? *Or will we fumble at the door latch while opportunity goes knocking elsewhere?*

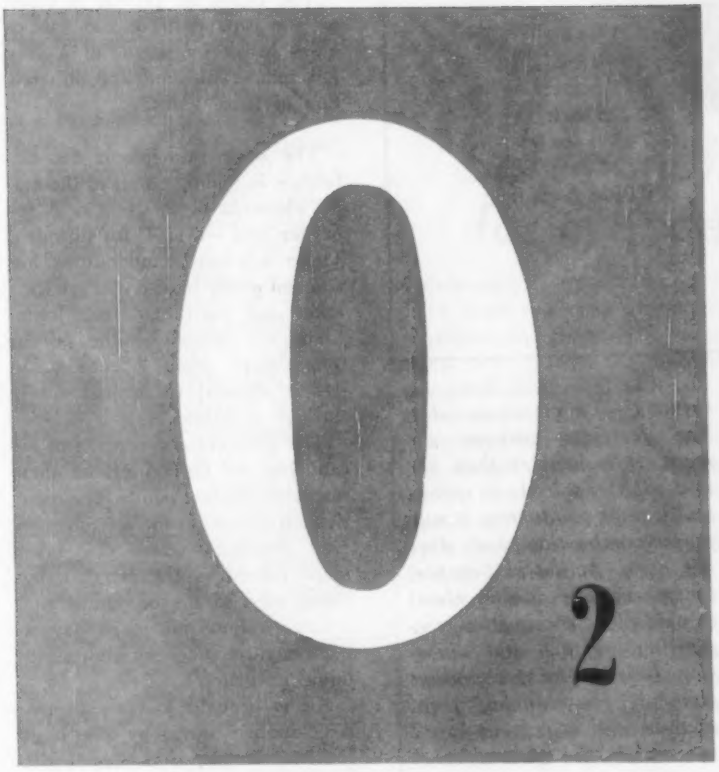
We should accept the challenge!

PICTURE
OF A WELDOR
REACHING FOR
SATISFACTION

HARNISCHFEGER
Milwaukee 46, Wisconsin

P&H
WELDING PRODUCTS
DIVISION

WELDING
ENGINEER



OXYGEN . . .

. . . its production
. . . distribution
. . . and uses

WALKING ON AIR is not just a figure of speech when you consider that oxygen constitutes some 50% of the weight of the earth's crust.

Oxygen, of course, is not air, but it does make up more than 20% of our atmosphere in its free gaseous form. This relatively small portion of oxygen in its elementary form is due to its tremendous combining power.

The major portion of the earth's oxygen is present as oxides of other elements, such as rocks, soil and water.

In 1774, the English chemist Joseph Priestly first discovered pure oxygen by heating mercuric oxide and collecting the resulting gas. (Three years earlier, Scheele of Sweden, working independently of his English counterpart, made the same discovery.)

Priestly noted that the gas differed from the atmosphere (a mixture of 20.9% oxygen with nitrogen) in that it greatly accelerated the rate of burning of combustible materials.

A glowing taper placed in a test tube containing this "new" gas burst into flame in a violent combustion reaction. Similarly, many metals normally considered noncombustible in air burned rapidly in the gas-filled test tube.

But since the gas itself did not burn, Priestly termed it a dephlogistic (phlogiston then being considered a secret element found in all burnable materials).

A few years later, the French chemist Antoine Lavoisier continued the studies begun by Priestly. Believing that the gas was

Oxygen Data

Approximate molecular weight	32
Latent heat of vaporization	92 BTU/lb
Sensible heat to 70 F (gas from —297 to 70 F)	80 BTU/lb
Total heat to 70 F (liquid at —297 to gas at 70 F)	172 BTU/lb
Thermal conductivity @ 32 F	0.0141/BTU/sq ft/hr F/ft
Gas constant (R) for oxygen	48.3
$K = \frac{Cp}{Cv}$ @ 68 F and at 1 atm.	1.4
Normal boiling point at 1 atm.	—297.4 F
Triple point temperature	—361 F
Triple point pressure	0.23 psia
Density of saturated vapor @ —297 F	0.296 lb/ft^3
Density of liquid @ —297 F	71.3 lb/cu ft
Specific volume @ std. conditions	12.08 cu ft/lb
Density of gas @ std. conditions	0.0828 lb/cu ft
Weight as compared to air (air = 1)	1.11
Lb liquid/gallon liquid	9.5
Std. cu ft gas/gallon liquid	115
Volume expansion, liquid to gas @ 1 atm., 70 F	860

found in all acids, the Frenchman gave oxygen (*acid former*) its name.

In the early 19th century, studies of the reactions of oxygen with other elements formed a major part of chemical investigation. However, no industrial applications were made of the combustion-accelerating properties of pure oxygen since it was available only on a laboratory scale.

Even though oxygen is present in largest quantities in the earth's crust and can be separated in its pure form by simply heating the oxides of certain metals, its commercial preparation from these sources was both slow and costly.

In the latter part of the 19th century, this process of separating oxygen was used for limited applications. However, not until the isolation of oxygen in water and air was discovered did oxygen become available in quantities needed for large-scale commercial application.

Under modern conditions, oxygen is normally extracted from the air. There are some oxygen-producing plants which separate the constituents of water (hydrogen and oxygen) in an electrolytic cell. Most oxygen, however, is produced by liquefaction of air and the subsequent separation of the liquid air into oxygen and nitrogen.

In the electrolytic process a direct electric current is passed through water, to which a small amount of acid or alkali (*e.g.*, caustic potash) has been added.

The electric current causes a decomposition of the water into its chemical elements with the oxygen being accumulated at the positive pole and the hydrogen at the negative pole.

The liquid air process is based on the separation of the various gases in air by means of a very low temperature and the liquefaction of these gases.

The basic principle is the difference in boiling points of the major elements of air: —295 F for oxygen and —317 F for nitrogen. These sub-zero temperatures are reached partly by external refrigeration and partly by the "Joule-Thompson effect" — the fall in temperature when a compressed gas is allowed to expand freely through a nozzle.

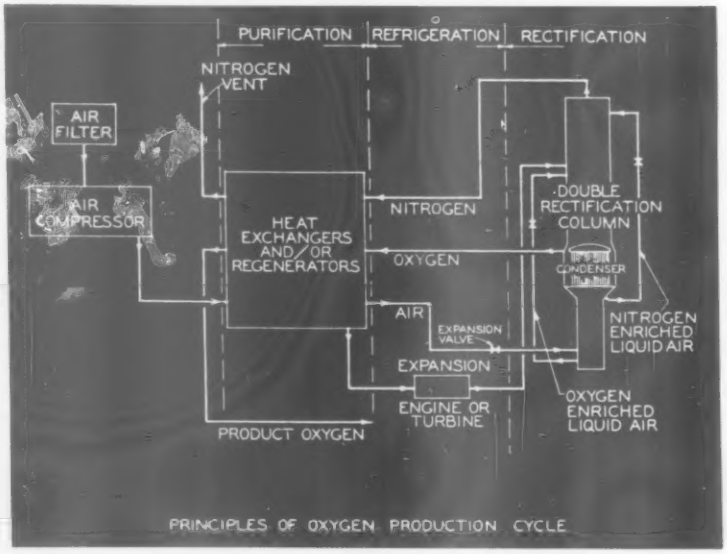
The different constituents of air can then be tapped off at their respective boiling points. The rectification column in the interchanger (*see drawing*) where this takes place resembles the fractionating tower used in the oil industry.

Here is how one major oxygen manufacturer produces high-purity liquid oxygen:

Air is brought in through two large suction towers by nine large four-stage compressors — each with

---

OXYGEN — *a colorless, odorless, tasteless gaseous element. It is heavier than air, and slightly soluble in water, and a poor conductor; it supports combustion but does not burn. Active and important chemically, it is involved in oxidation, combustion, respiration, rusting and corrosion. It is the most abundant element, forms many compounds, and is present in all life and in the atmosphere.*



PRINCIPLES OF OXYGEN PRODUCTION CYCLE

a capacity of 295,000 cfh and driven by a 2,000-hp electric motor. Before entering the compressors the air is cleansed by passing it through glass-wool filters.

The compressors boost the raw atmospheric air, in steps, up to about 2,200 psi. The air then moves to its first cooling stage where ammonia heat exchangers lower air temperature to —40 F.

From this first cooling stage (the only one where a refrigerant other than the air itself is used), the subzero air is sent to expansion booster engines, which take part of it for their power and part for refrigerating purposes. About 35% of the air is used for added refrigeration.

This air is later returned to the cycle (there is no loss at this point) where the air has dropped to —283 F, almost the liquefaction point.

To drop air temperature, the laws of expansion are used throughout the cycle. Large volumes of air are forced through small orifices. The expansion valve at the interchange is the key to the entire liquefaction process.

Forcing air into the interchanger, which houses the rectification column, through a ½-in. expansion valve at 2,000 psi has a tremendous cooling effect.

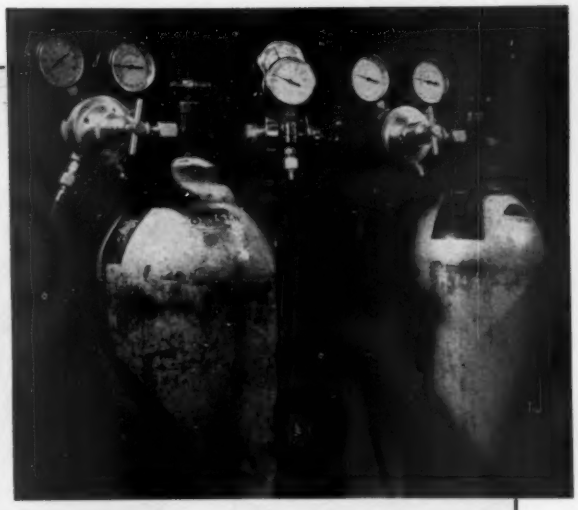
In the interchanger, air is scrubbed free of carbon dioxide, moisture and other impurities. The cleaning action is accomplished through use of traps and stone filters. After the air is cleansed, it reaches the rectification column, the heart of the interchanger.

Here the main constituents are boiled off. Nitrogen and argon are tapped off and diverted to storage areas; both remain in liquid form.

After oxygen has liquefied and leaves the interchanger, it is run through more stone filters and then stored at atmospheric pressure.

Oxygen is constantly checked for purity in the interchanger, as well as later in the storage tanks. The pressure into the end of the interchanger determines temperature, which in turn controls the test (purity) of the oxygen, nitrogen and argon.

For a definitive report on the problems of distribution and storage of oxygen, see page 28.



Safe handling procedures for cylinders and oxygen

Cylinders

To avoid ruining or damaging regulators by arc-burning, never allow the cylinder to become grounded; insulate it with wood or rubber.

Keep all work tables or welding fixtures safely away from contact with oxygen storage units. If this is not practical, then install a guard between the tank and any work in progress.

Before moving any oxygen cylinder, be sure the valve protection cap is on straight and tight. If a container must be lifted, be certain the cap is firmly fastened, then lift the cylinder to a standing position.

When a cylinder valve cannot be opened by hand, do not force it. After a job is finished, make a definite point of closing the valve.

If a defective cylinder is received, do not try repairing it. Tag it so others will not use it, and then call the supplier immediately for a replacement.

Moving a cylinder any long distance should be done on a truck equipped with a chain to prevent fall-over.

When transporting the cylinder to the truck, roll it on the bottom edge; dragging or sliding it is dangerous.

Cylinders are heavy and should be anchored securely to prevent any damage or personnel injuries from falling.

Gaseous Oxygen

Keep any burning substance or combustibles away from oxygen supplies, and post "No Smoking" signs.

Never use oil on oxygen equipment; do not allow oil or grease to come in contact with oxygen.

Before connecting a regulator, always remove dirt from a high-pressure oxygen cylinder.

To prevent regulator seat overheating when the regulator is in place, open cylinder valve slowly.

Never subject cylinders to heating, since this can increase pressures to dangerous proportions, and also cause damage to the cylinder.

Do not tamper with valves, markings or safety devices.

Liquid Oxygen

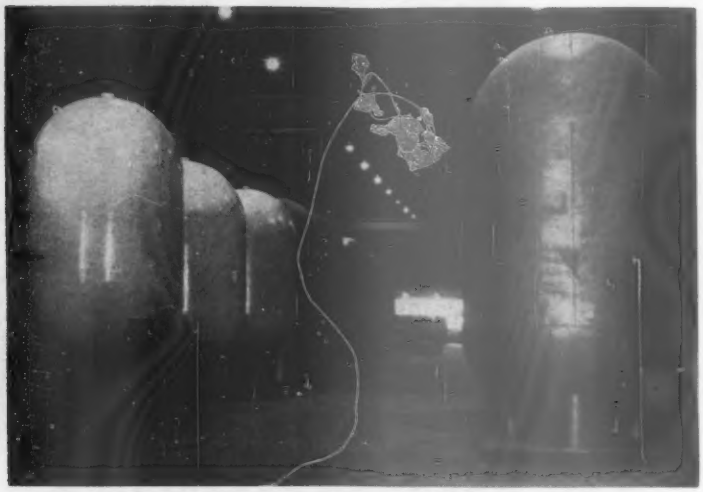
Keep any burning substance or combustibles away from oxygen installations. Post "No Smoking" signs.

Never allow liquid oxygen to contact skin, uninsulated lines, valves or fittings since serious burns may result.

Never trap liquid oxygen in a line between two valves. Tremendous pressure build-up can cause damage to both personnel and equipment.

Keep all oil and grease away from liquid oxygen.

Never tamper with safety devices on liquid oxygen receivers.



LIQUID oxygen "customer stations" built by Standard Steel Corp.'s Cambridge Div. cut down need of frequent cylinder delivery. Two major oxygen producers have placed orders for 14 of these vacuum-jacketed storage vessels, each of which has the equivalent of 300,000 cu ft of gaseous oxygen.

by Gregory Cannizzo

Economical oxygen distribution, storage a must as demands soar

THE FINAL PRICE OF ANY PRODUCT, from hairpins to pinions, must include the cost of getting it there, and the cost of keeping it there.

These two considerations of distribution and storage are becoming more important as industrial demands for oxygen continue to push total production of this gas to new highs every year.

With this growth of the oxygen industry has come a realization of the increased importance of oxygen purity and the need for lower production and distribution costs.

Before 1900 practically all oxygen was produced electrolytically and a purity of 95-97% was considered standard for all uses. With the development of the liquefaction process, oxygen became available in large quantities with a purity of 99.5% or better.

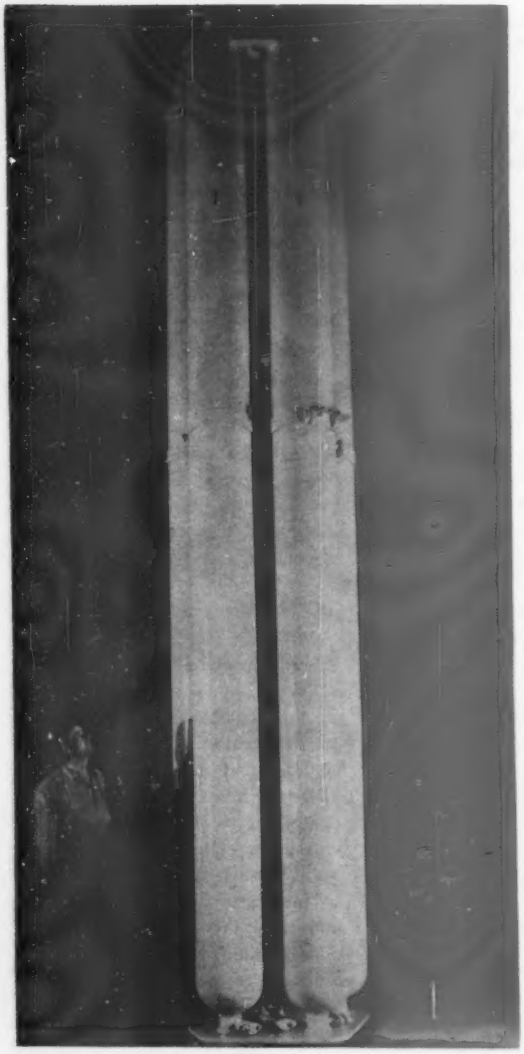
Cost of liquefaction plant construction, plus demands for higher purity oxygen prompted a shift toward building the high-purity plants only where required. Less expensive, lower-purity (95%) oxygen plants were constructed near steel and chemical producers who could use the less pure oxygen.

But development of new steel and chemical making processes pushed these industries into the high-purity oxygen market.

As gas cylinder costs and handling charges increased, and as missile and space programs demanded more liquid oxygen, marketing of the liquefied gas to substations and large consumers developed.

Now large centralized producing plants with daily capacities up to 1,000 tons are being installed.

But the problem of distribution is still not completely solved. Basically there are two methods of transporting oxygen — in containers or by pipeline.



ASSEMBLY of five high-pressure storage tanks will be installed upright some 80 ft under a launching silo for the Titan missile. The liquid oxygen tanks were manufactured by U. S. Steel Corp.'s National Tube Div.

Selection of either method depends on the amount of oxygen to be used.

The distribution system of one large oxygen manufacturer begins with the large liquid oxygen storage tank at the centralized production plant. (*For details on oxygen production, see preceding article.*)

From here the liquid oxygen is shipped by transport trailers, mobile pumping units and railway tank cars. (The pumping units are trucks equipped to convert the liquid oxygen into gas at the customer's business site.)

All these transportation units are designed, of course, to maintain the low (−297.3 F) temperature needed to keep the oxygen liquefied.

Some of the liquid oxygen is delivered to filling stations in remote areas where a large oxygen production plant is not justified. Other liquid is delivered directly to the customers.

At the filling stations, cylinders are filled with gaseous oxygen and delivered to the customer by truck. Or small, portable liquid oxygen containers may be filled and used as an immediate source of supply since they can convert the liquid to gas.

Still another way is for a pumping unit to bring the liquid from the filling station to the customer, and there either fill a rack of high-pressure receiver tubes with gaseous oxygen, or fill a cold converter with liquid oxygen for use by the customer as he needs it.

(These converters are equipped with vaporizers and superheaters that automatically convert any required amount of liquid oxygen to gas.)

Other customers have their cascaded receiver tubes and cold converters filled from pumping units arriving directly from the production plant. Customers with large liquid storage tanks have their liquid oxygen delivered directly from the producing plant by trailer truck or railway tank cars.

But even with the economies of liquid oxygen, demand loads void some of its transporting advantages. So the current trend is toward on-site oxygen plants, with the gaseous oxygen being delivered to the user by pipeline. (*See box.*)

Authorities all agree that on-site oxygen production is the answer to the high demand for the gas — but the big question is: Who will own and operate the plant?

The oxygen manufacturers say they should — and they have three strong arguments with which to support their claims to ownership. They are:

An indication . . .

of the trend in oxygen distribution can be seen in a recent survey made by the Business and Defense Services Administration, U.S. Dept. of Commerce. In one year, distribution of gaseous oxygen by pipeline direct from the producer's generators to consuming points jumped from 35.5% of total high-purity oxygen shipped to 55%. Greatest decrease was in shipments of liquid oxygen by truck and railway tank car to substations.

U.S. Oxygen Production

	High-purity grade[1]		Lower-purity grade[2]		Total oxygen		
Year	Billions of cu ft	Thousands short tons	Billions of cu ft	Thousands short tons	Billions of cu ft	Thousands short tons	% Total high-purity
1950	17.8	783	—	—	—	—	—
1951	22.3	926	—	—	—	—	—
1952	23.9	992	—	—	—	—	—
1953	25.3	1051	—	—	—	—	—
1954	22.1	919	11.1	463	33.2	1382	67
1955	29.3	1218	16.0	663	45.3	1881	65
1956	33.3	1383	23.5	977	56.8	2360	59
1957	33.8	1405	27.7	1150	61.5	2555	55
1958	36.1	1500	26.8	1113	62.9	2613	57
1959	45.1	1875	33.7	1400	78.8	3275	57
1960[3]	29.1			750.7			

1—Includes all liquid oxygen produced in privately owned plants.

2—Production of lower-purity grade was not reported before 1954.

3—Figures for 1960 are from January to June.

(1) The gas is cheaper (as little as 5 cents per 100 cu ft).

(2) Cost of plant and equipment would be their concern; thus freeing the user's capital for other investments in his business.

(3) They guarantee the user an uninterrupted supply of gaseous oxygen, providing capacity for peaks and for protection against possible breakdown of oxygen-producing equipment.

(They can guarantee these capacities by means of storing liquid oxygen — usually on-site or close by, or by shipping from the large oxygen-producing plants.)

The final argument proffered by the oxygen producers is the value of their experience. Gas suppliers claim the advantages of specialized skills, consolidation of replacement parts and prime interest.

For the most part, users have accepted these reasons. Of 18 new oxygen plans scheduled for the next two years, only one will be owned and operated by the user himself.

In the mid-1950s more than half of the on-site capacity was user owned. By the time proposed expansions are on-steam, oxygen producers will own nearer 85% of all the on-site capacity.

The oxygen industry's on-site plant marketing methods have ranged from outright sale of oxygen generators, through generator lease arrangements, to the sale of product.

Linde Co., Air Reduction Co. and National Cylinder Gas Div. are three major oxygen suppliers which have always sold product, but not equipment.

(Linde-built on-site oxygen plants are operated by Linde personnel as well.)

Air Products Co. began as a supplier of either plant or product, as well as acting as a plant lessor, but in recent years has turned from selling oxygen equipment for steel applications.

Still selling plant or product and/or leases are Independent Engineering Co., Inc., and Superior Air Products Co.

One company, Dravo Corp., disputes all the arguments cited by the oxygen suppliers for owning and operating on-site oxygen facilities.

According to Dravo, all oxygen costs must be paid by the user whether the plant is supplier-owned or user-owned. The only difference is the outside profit of the supplier-owned plant, which the firm feels is a significant difference.

The firm claims that a tonnage oxygen plant can be constructed for as little as $12,500 per daily ton of capacity. For a 300-ton facility this could mean a charge of $8.20 per ton of oxygen.

(Dravo is building the one user-owner oxygen facility of the proposed 18 mentioned above.)

Chemical & Industrial Corp. of Cincinnati supports Dravo Corp.'s point of view.

Production to meet the high demands for high-purity oxygen is just one of the problems confronting the oxygen industry. Getting it to the user, quickly and economically, is another — and just as important.

Oxygen rising plants,

WHAT IS THE OXYGEN INDUSTRY doing to cope with the growing demands for this high-purity gas and its economical distribution?

Evidence of the industry's efforts can be seen in the air separation plants mushrooming across the country.

New plants are being built; on-site facilities are being expanded to include industries other than steel producers; existing air separation plant capacities are being increased. Items:

¶ **Air Reduction Sales Co.,** New York City, has two more on-site plants scheduled for the near future. One, a 675-ton-per-day plant, will be located at Johnstown, Pa., while the second, a 350-ton-capacity air separation facility, will be at Clayton, Del.

Two other existing on-site liquid oxygen plants are in operation. One is at Butler, Pa., (supplying 345 tons of oxygen daily to Armco Steel Co.) and the other is the recently expanded oxygen facility at Fairfield, Ala., (150 tons) which will supply the Tennessee Coal & Iron Div. of U. S. Steel Corp.

The firm has approximately 70 oxygen-producing plants, including seven other liquid oxygen facilities located at:

Acton, Mass.	**205 tons**
Baton Rouge, La.	**30 tons**
Chicago, Ill.	**75 tons**
City of Industry, Calif.	**75 tons**
Richmond, Calif.	**65 tons**
Riverton, N. J.	**150 tons**
Tampa, Fla.	**30 tons**

In addition, Airco distributor conversion stations are located at Goss Bros. Welding Supply Co., Falls Cheek, Pa.; Kankakee Welding & Supply Co., Kankakee, Ill.; and Jackson Welders Supply, Jackson, Mich.

¶ **Southern Oxygen Co.,** Washington, D. C., celebrating its 45th anniversary, does not operate any on-site oxygen plants, but does have six oxygen producing plants (two are liquefaction units) and six liquid oxygen storage and conversion cylinder facilities.

The two liquid oxygen plants are located at Bladensburg, Md., (25 tons per day) and Kingsport, Tenn., (17 tons).

The remaining four are gaseous oxygen facilities located at Vineland, N. J., and at Greensboro, N. C. (100 meters each) and two in St. Petersburg, Fla., with 40 and 30 meters each.

Storage and conversion facilities are located at: Mercer Oxygen and Supply Co., Trenton, N. J.;

LIQUID oxygen plant (preceding page) at Baton Rouge, La., produces 30 tons daily for Air Reduction Sales Co.'s customers.

producers meet demands with new expanded facilities

Southern Oxygen Co., Vineland, N. J.; Carolina Air Products, Wilmington, N. C.; Southern Oxygen Co., Greensboro, N. C.; Chattanooga Welding Supply Co., Inc., Chattanooga, Tenn.; and Mid-South Oxygen Co., Atlanta, Ga.

¶ **Linde Co.**, New York City, maintains more than 60 plants for producing liquid or gaseous oxygen (as well as other gases). Some of the centrally-located liquid oxygen facilities are:

Ashtabula, Ohio	500 tons
Birmingham, Ala.	20 tons
Essington, Pa.	500 tons
East Chicago, Ind.	900 tons
Kittanning, Pa.	700 tons
Houston, Texas	40 tons
Seattle, Wash.	20 tons

Most of the firm's on-site plants are operated for single-customer use and produce high-purity gaseous oxygen. Capacities range from 10 to more than 500 tons per day.

About 650 liquid storage or combination storage and conversion units in service at customer, distributor or mass-plant locations provide capacities of 10 thousand to 75 million cu ft.

¶ **Victor Equipment Co.**, San Francisco, with two 14-ton-capacity liquid oxygen plants at Sacramento and La Habra, Calif., make this firm one of the largest independent oxygen producers in the west.

Most of the firm's gas is distributed in cylinders by trucks operating from 14 branches throughout California. In addition, the firm also distributes through numerous resellers. The two largest are: Gordon Duff, Inc., Los Angeles, and Douthitt Oxygen Co., El Centro.

Each is equipped with liquid pumping stations with storage capacities of 250,000 cu ft each. One other liquid oxygen pumping station is located in San Diego, has a storage capacity of 500,000 cu ft.

¶ **Air Products, Inc.**, Allentown, Pa., maintains five on-site oxygen producing units:

Cleveland, Ohio	580 tons
Pittsburgh, Pa.	340 tons
Sparrows Pt., Md.	350 tons
St. Louis, Mo.	170 tons
Wheeling, W. Va.	650 tons

The firm's present daily capacity for steel and metalworking industries is reportedly 1,700 tons, and is expected to more than double in 1961 alone.

The company also supplies 14 districts with industrial and medical gases from centralized plants (most recent addition, Valley Industrial Park just south of Minneapolis).

¶ **National Cylinder Gas Div. of Chemetron Corp.**, Chicago, owns five on-site oxygen plants at steel mills and operates 32 other oxygen producing plants in major cities from coast to coast.

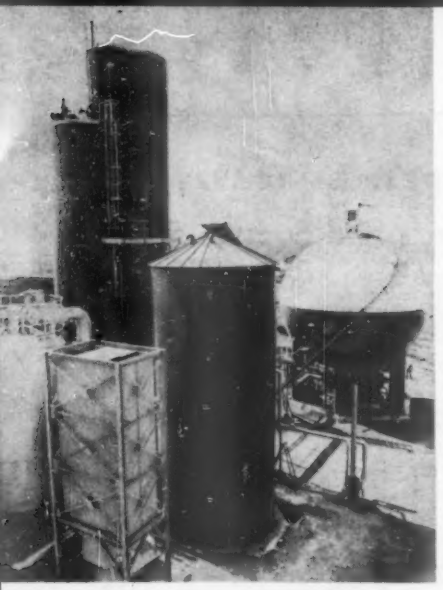
The firm also has nine dealer pumping stations located at Mansfield, Ohio; St. Louis, Mo.; Royal Oak, Mich.; Marinette, Wis.; Bismark. N. D.; Shreveport, La.; Grand Rapids, Mich.; and Gering, Neb.

¶ **Liquid Carbonic Div. of General Dynamics Corp.**, Chicago, produces oxygen in 19 plants located in 13 different states. The firm's regular oxygen market covers a total of 25 states through the facilities of approximately 300 dealer distributors.

Liquid oxygen facilities are located at Oakland, Calif.; Urbana, Ohio; Detroit, Mich.; and Harrison, N. J. An additional liquid oxygen facility is expected to be announced in the near future.

WE's Complete List of Oxygen Producers and Suppliers

Acetogen Gas Co., Detroit, Mich.
Acetylene Gas Co., St. Louis, Mo.
Acetylene Service Co., Denver, Colo.
Air Products, Inc., Allentown, Pa.
Air Reduction Sales Co., New York, N. Y.
Alabama Oxygen Co., Birmingham, Ala.
Alaska Oxygen Co., Fairbanks, Alaska
Aldan Oxygen Mfg. Co., Inc., Collingdale, Pa.
American Compressed Gas Prods., Inc., Ft. Wayne, Ind.
American Gas & Chemical Co., Harrison, N. J.
Atlas Acetylene Co., Kearney, N. J.
Balbach Co., The, Omaha, Nebr.
Big Three Welding Equipment Co., Houston, Texas
Burdett Oxygen Co., The, Cleveland, Ohio
Cia. Productora De Oxigeno, S. A., Monterey, Mexico
Commercial Gas Corp., Wilkes-Barre, Pa.
Commonwealth Prods. Co. de Mexico, S. A. Mexico, D. F.
Compania Mexicana AGA. S. A., Mexico, D. F.
Compania Mexicana de Soldadura Autogena, S. A., Mexico
Corpus Christi Oxygen Co., Corpus Christi, Texas
Delta Oxygen Co., Memphis, Tenn.
Dye Oxygen Co., Inc., Phoenix, Ariz.
Denver Oxygen Co., Inc., The, Denver, Colo.
Thomas A. Edison, Inc., Stuyvesant Falls, N. Y.
Gases Agamex, S. A., Mexico
Gases Industries, S. A., San Luis Potosi, Mexico
Gulf Oxygen Co., Inc., Lake Charles, La.
Gaspro Ltd., Honolulu, Hawaii
Houston Oxygen Co., Houston, Tex.
Independent Engineering Co., O'Fallon, Ill.
Indiana Oxygen Co., Indianapolis, Ind.
Industrial Air Products Co., Portland, Ore.
Kansas Oxygen, Inc., Hutchinson, Kan.
Keenan Welding Supplies Co., Albany, Ga.
Linde Co., New York, N. Y.
Liquid Carbonic Div., General Dynamics Corp., Chicago
Maine Industrial Gas Co., Lewiston, Me.
Maine Oxyacetylene Co., Auburn, Me.
Marks Oxygen Co., Augusta, Ga.
McDonald Co., B. F., Los Angeles, Calif.
National Cylinder Gas Div., Chemetron Corp., Chicago
National Welders Supply Co., Charlotte, N. C.
Oklahoma Oxygen Co., Tulsa, Okla.
Oxigeno de Tampico, S. A., Tampico, Tamps., Mexico
Pacific Acetylene Co., San Diego, Calif.
Pacific Oxygen Co., Oakland, Calif.
Puritan Compressed Gas Corp., Kansas City, Mo.
Sabine Oxygen Co., Port Arthur, Texas
Sierra Oxygen Co., Reno, Nevada
Southern Oxygen Co., Washington, D. C.
Steele Gases, Inc., Forest Park, Ill.
Stewart Oxygen Co., San Francisco, Calif.
Superior Air Products Co., Newark, N. J.
Superior Industrial Gas Corp., Astoria, N. Y.
Superior Oxyacetylene Machine Co., Hamilton, Ohio
Tex-Air Gas Co., Inc., Amarillo, Texas
Trinity Oxygen Co., Ft. Worth, Texas
Valley Oxygen Co., Bay City, Mich.
Valley Oxygen Co., Hanford, Calif.
Welders Supply Co., Little Rock, Ark.
Welding Gas Products Co., Chattanooga, Tenn.
Welding & Industrial Prods., Ltd., Honolulu, Hawaii
West Texas Oxygen Co., Lubbock, Tex.
Western Oxygen, Inc., Seattle, Wash.
Whitmore Oxygen Co., Salt Lake City, Utah
Wolverine Gas Products, Inc., Saginaw, Mich.



NEWEST on-site oxygen plant for steel industry is 500-ton facility built for Great Lakes Steel Corp., Ecorse, Mich., by Linde Co. This third major installation of 1960 brought Linde's on-site oxygen capacity to 3,623 tons per day. Ten other on-site plants are either under construction or scheduled.

Diverse industries consume over 50 billion cu ft of high-purity oxygen yearly

FROM THE FAR REACHES of space, to the local hospital, to the depths of the sea — the average man knows the many uses to which manufactured oxygen is put in order to sustain life.

What he doesn't know is that all oxygen consumed for respiratory purposes makes up only a relatively small percentage of the total high-purity oxygen production in the United States.

Even the welding industry with its many applications for high-purity oxygen uses less than 10% of the total amount produced.

The logical question then is: **Where does the more than 50 billion cubic feet of this oxygen go in a given year?**

The answer: more than half of the total high-purity oxygen produced goes to the steel industry. (*See table* 1.)

This increased consumption by the steel mills has caused production of high-purity oxygen to more than double since 1954 — and the trend is still upward.

A second logical question would be: **If the steel industry uses so much oxygen, why hasn't oxygen production been affected by the steel industry's lower percentage-of-capacity production?**

Answer: those steel companies utilizing oxygen in their production prefer to bank the older, less-efficient furnaces and to operate the oxygen-equipped ones. During the past year, for example, while steel mills were operating (at one point) at 50% of capacity, oxygen converters continued working at 80% of capacity.

To what use does the steel industry put all this oxygen?

A breakdown of oxygen usage in 60 steel mills shows these applications: metallurgical, 62%; scarfing, 27%; construction and maintenance, 6%; and scrap separation, 5%. (*For a more complete breakdown, see table* 2.)

Conservative oxygen suppliers estimate high-purity oxygen consumption to at least triple in the next five years. The more optimistic forecasters see a sixfold increase. Both could be on the low side.

In the open hearth furnace, undershot end-burner oxygen used for combustion greatly speeds scrap

High-purity oxygen uses

Usage*	Percentage of total	
	Changes over two recent years	
Aircraft[1]	3.4	5.9
Chemicals production[2]	1.4	1.5
Medical and aviation	5.4	5.3
Petroleum production and refining	0.6	0.6
Railroads	2.0	1.4
Shipbuilding and repairs	1.4	1.7
Blast furnace and steel mill foundries	58.9	59.7
Fabricated metal parts	9.4	8.0
Machinery and electrical	4.3	3.6
Other metal production, fabrication uses	0.3	0.3
Direct sales to government	1.2	2.2
Miscellaneous uses	11.7	9.8

**Business and Defense Services Administration survey.*

1 — Includes an unidentified quantity of liquid oxygen furnished to industry for government use.
2 — Acetylene, oxo compounds and miscellaneous chemicals.

TABLE 1 — End uses of high-purity oxygen produced by industry.

Survey of Oxygen Usage in 60 Steel Mills

Open hearth roof jets	25%
Open hearth combustion oxygen	15
Hand scarfing	14
Open hearth decarburization	13
Machine scarfing	13
Miscellaneous metallurgical	8
Construction and maintenance	6
Scrap separation	5
Blast furnace	1

TABLE 2 — Percentage breakdown of oxygen usage in 60 steel mills.

meltdown. During the refining phase, when scrap charging is completed, hot metal is added and roof jets inject pure oxygen directly into the mixture. Thus, increased production with lower capital investment than for new facilities is made possible.

Prior to present-day oxygen practices, an efficient open hearth could produce about 30 tons of steel per hour. Using oxygen, some mills make almost 40 tons per hour on a regular basis. On a test basis, using new injection techniques, open hearths have produced more than 100 tons an hour.

Thus, oxygen, when used on open hearths, provides increased efficiency, as well as capacity, with minor modifications.

In the electric furnace (where carbon steel as well as many stainless and high-alloy steels are made) oxygen gas burners speed meltdown, resulting in faster scrap charge melting with reduced power costs and less electrode breakage. The oxygen jets produce higher temperatures faster, speeding refining and reducing loss of expensive alloying elements.

In the ferromanganese blast furnace, a small percentage of oxygen enrichment in the air blast makes for a substantial increase in production.

(To help the steel industry obtain similar results in the iron blast furnace, Linde Co. conducted investigations which resulted in a technique allowing an electronic computer to represent a blast furnace in operation. All complex interactions which take place in an actual furnace are programmed into the computer. Test furnaces have shown that the technique can lead to production increases of 25 to 30% while decreasing required coke amounts.)

Scarfing, the flame-conditioning of steel billets, blooms and slabs, removes surface defects from the steel. Large volumes of oxygen are used in scarfing machines which automatically remove defects from steel sections as they are rolled. Hand scarfing and heavy oxygen cutting of large iron and steel castings also consume substantial amounts of oxygen in steel mills and foundaries.

Taconite mining uses large volumes of oxygen in jet-piercing. Using this technique to pierce and undercut blast holes in the taconite, the extremely hard iron ore can be mined quickly and economically, and is making vast reserves of taconite available.

Oxygen is definitely revolutionizing the steel industry. But as in any revolution, there are fringe problems to be solved; in this case, distribution and storage of the oxygen. (*See page* 28, *this issue.*)

Everyone connected with oxygen — producers and users — agree that on-site oxygen facilities are one answer to the increasing demand for the 99.5%-plus pure oxygen. And most of the steel mills seem to have accepted the idea of supplier-owned facilities.

Of 18 new oxygen plants scheduled for steel mills, only one, Ford Motor Co., Dearborn, Mich., will be user owned. The others will be owned and operated by the respective oxygen producers.

In still another step for more rapid and economical oxygen supply, there is a trend toward "on-site" oxygen plants to serve numerous steel plants in one area via pipeline. The oxygen-producing facility would be located near the steel mill grouping.

One such facility, a 1,000-ton capacity plant, is reportedly being planned by one producer for a group of steel mills in the Pittsburgh area.

In addition to the steel industry there has been a rapid growth of on-site oxygen plants in the chemical and missile industries. Total on-site capacity percentages are: steel, 45; chemical, 41; missile, 13; and others, 1.

At the rate oxygen facilities are being built for the steel mills, however, the steel industry will continue to lead in oxygen consumption despite increased demands by chemical and missile producers.

Five Points to Remember

1 — Oxygen supports combustion in combustible materials; does not burn; is not combustible by itself.

2 — Oxygen must never be called air; confusion could be fatal.

3 — Fire resistance describes combustion characteristics in air. In pure oxygen many non-combustible and most fire resistant materials can burn readily, including most powdered metals.

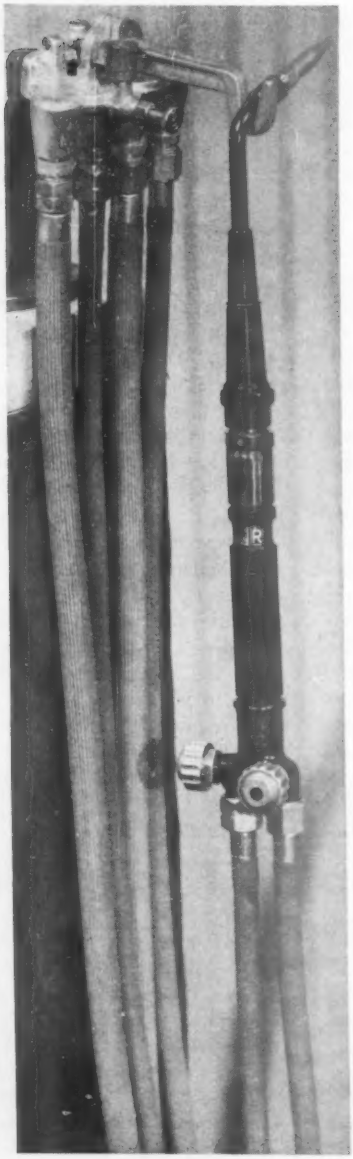
4 — In pure oxygen a spark can cause immediate and flaming combustion of clothing and fuels.

5 — LOX is a tradename for a liquid oxygen explosive, and should not be used to describe liquid oxygen, a non-explosive.

What you should know about . . .

Oxygen pressure reducing regulators

by **Harris A. Goodwin**
Regional Manager
The Bastian-Blessing Co.
Chicago, Ill.



- ✓ Combustion
- ✓ Seat ignition
- ✓ Cylinder pressures
- ✓ Two-stage regulators

AUTOMATIC PRESSURE-REDUCING regulators were already in use in certain industries in the latter part of the 19th century and the probable forefather of the present oxygen regulator was a carbon dioxide pressure reducing regulator.

With the development of billet piercing and drawing processes, the seamless drawn cylinder made its appearance.

Development of truly high-pressure oxygen cylinders in a compact container dictated development of an automatic regulator to reduce high initial pressures to values which could be controlled by manual means.

The first such regulators were minor modifications of carbon dioxide regulators which had been in use for some time. Early designers of pressure-reducing regulators had little knowledge of some of the critical characteristics and phenomena in controlling the behavior of oxygen.

Combustion

Since oxygen has a high affinity for rapid and violent combustion with certain substances including all hydrocarbons plus iron and steel, it has been the general practice to limit construction of oxygen pressure-reducing regulators to non-ferrous materials.

In addition, meticulous care must be employed to degrease all parts and exercise general precaution against contamination by hydrocarbon lubricants during regulator assembly.

To avoid the possibility of spontaneous combustion from exposure of oxygen to such lubricants, the basic warning, "use no oil," is usually posted on welding equipment pressure gages.

Technical definition

Technically, a pressure reducing regulator is a device which automatically reduces a variable high pressure to a constant lower pressure and maintains this reduced pressure at a relatively "constant" value while delivering either a variable or a constant volume of gas.

Essential components

The essential parts of such a regulator must include a flexible diaphragm, a valve seat disc, a companion valve nozzle, and a means of loading the diaphragm variably to produce the desired delivery pressure. The device must include a high-pressure inlet connection and a suitable outlet connection, together with two connections for the attachment of one cylinder-pressure-indicating gage and one delivery-pressure gage.

The flexible diaphragm may be of a selected non-ferrous metal or a suitable synthetic-rubber-impregnated fabric, either nylon or cotton cord or a combination of both

Seat ignition

One of the earliest problems which assailed the oxyacetylene industry was related to the spontaneous ignition of regulator seats.

Exploration of this problem revealed that all seating materials are subject to spontaneous ignition when certain conditions are present. These conditions include: a cylinder pressure 1,500 psig or higher; a

METALLIZING operation is made possible by the use of these oxygen pressure-reducing regulators.

badly worn seat disc material tending to produce a tinderous surface resulting from plowing up from the indenture of the nozzle into the semi-resilient seating material; and oxygen which is relatively free from liquid moisture.

Assume that under these conditions the adjusting screw of the regulator is released to allow the seat disc to close off against the nozzle, and thereafter the cylinder valve is suddenly opened. The sudden recompression of the single atmosphere of oxygen present in the inlet channel, driven forward by the incoming high-pressure gas, is then concentrated and recompressed in close proximity to the worn seat.

This can produce a spontaneous ignition which can lead to the total destruction of the regulator. This is the principle on which the diesel engine ignition is based.

Research has revealed that *theoretical* adiabatic compression heat of pure oxygen from atmospheric pressure to 2,000 psig (135 atmospheres) is actually 1,753 F. By inserting a thermocouple into a regulator, actual temperature rises have been measured as high as 900 F, indicating that the actual absorption of this heat of recompression into the walls of the passage is about 50% effective.

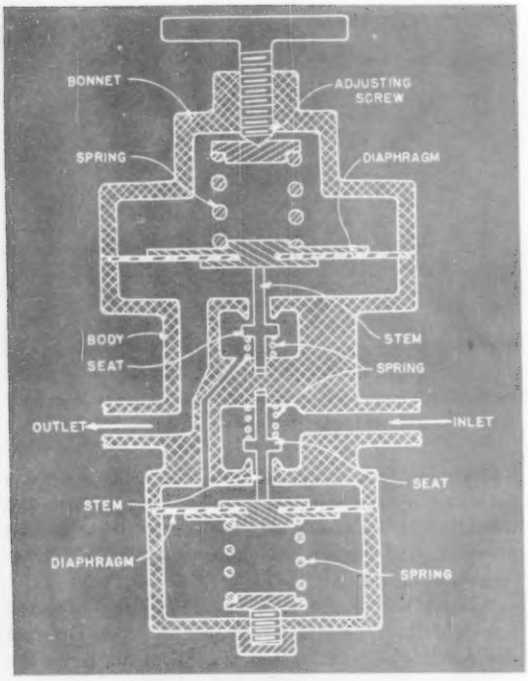
Since seating compositions ignite under these conditions many means have been developed by regulator manufacturers to safeguard against heating concentration at this point.

Cylinder pressures

During World War II, the acute shortage of containers led to two developments:

1—Bureau of Explosive regulations were amended to permit overcharging of oxygen and similar containers by as much as 10% over normal charging pressure, provided the safety relief device consisted of an *unsupported* safety disc. This meant removal of 212-deg fuse metal which supplemented and supported frangible safety disc material.

2—Metallurgical developments and improvements in steel strength led to development of ICC 3A2265 cylinders which permitted normal charging to 2,265 psig, and with the unsupported safety disc, an additional 10% overcharging. Still later, seamless drawn steel cylinders constructed of chromium-molybdenum alloy steel (chrome-moly) bore specification 3AA2400



TWO STAGE regulators can be of four types. This one is stem-type in both stages.

which permits 100% charging to 2,400 psig and 110% charging to 2,640 psig.

These increases in pressures and nominal increase in volumetric displacement have produced increased charging capacities up to 300 and 330 cu ft respectively in larger cylinders. This represents a 65% cargo capacity.

Two-stage regulators

Obviously these progressive increases in working pressure do not simplify the problems inherent in the production of dependable and safe pressure-reducing regulating equipment.

Of course, the higher the initial charging pressure, the greater the decline which will occur as the container pressure diminishes from full to empty. This important fact has had great influence on the demand for means of stabilizing delivery pressure so as to produce constant reduced pressures at the consuming appliance.

Two-stage pressure reducing regulators have come into common use and are based upon the simple principle that if pressure reduction can be accomplished in two separate stages, greater efficiency and stability of reduced pressure will result.

By proper proportioning of diaphragm and nozzle areas, it is possible in modern two-stage regulators to virtually balance off variations inherent in nozzle-type regulators and stem regulators. This results in delivery pressure which is, for all practical purposes, constant as container pressure diminishes from full to almost empty.

A two-stage oxygen regulator consists essentially of a relatively compact, high-pressure, first-stage regulator preceding a second-stage regulator of relatively larger proportions, all combined in one integral body.

Present day models usually have the first stage pre-fixed to reduce the container pressure to approximately 10% of the initial cylinder charging pressure. Regulators of this type are constructed according to the four different design arrangements as follows:

1—Positive (nozzle type) first stage with negative (stem type) second stage.

2—Negative (stem type) first stage with positive (nozzle type) second stage.

3—Positive (nozzle type) both first and second stage.

4—Negative (stem type) both first and second stage.

Still further variations in two-stage regulators occur since some designs include "direct construction" in one or both stages, while others may incorporate "indirect construction" in both or the alternate stages. depending upon the design ideas of the particular manufacturer.

Cylinder regulators

Single-stage and two-stage oxygen pressure reducing regulators are constructed in sizes to accomodate use with individual high-pressure cylinders. In addition, larger models of the same basic regulator types are constructed for master service to control the flow of gas from a cylinder discharging manifold where, of course, the capacity demanded would be substantially greater.

It is important to note that the capacity of an oxygen regulator is frequently and erroneously confused with the pressure at which the gas discharges on the reduced pressure side. Actually, the capacity of the regulator is a function of the available differential pressure drop across the nozzle orifice.

The higher the pressure coming into the regulator and the lower the pressure coming out of the regulator, the greater the volume of gas which can be discharged across a given nozzle orifice size. This also means that a regulator's discharge capacity will be greatest when cylinder pressure is highest.

Therefore the selection of an oxygen regulator should be made by careful study of its rated capacity at the lowest contemplated residual pressure at which the cylinders are to be employed.

An interesting technique minimizes the difficulties of this problem by incorporating a system of automatic regulator throwover in cylinder discharge systems.

In this arrangement, the discharge pressure from the regulator connected to the service battery of cylinders will be set for a nominally higher delivery pressure than the adjusted delivery pressure being fed into the same common discharge line from a regulator supplying gas from a reserve battery of cylinders.

Line station regulators

Where a manifold system is employed to distribute oxygen through a piping system to a group of operating stations, individual "station regulators" are employed at individual locations.

Since transmission pressure in the pipe line will be held to a relatively static value of perhaps 150 psig (not over 300 psig in most cases), a conventional

high-pressure oxygen regulator will be supplanted by a type designed to more accurately control this lower inlet pressure.

These so-called line station regulators usually have substantially larger orifice nozzles and almost invariably have very flexible, sensitive composition diaphragms.

This type of regulator construction is especially suited to requirements imposed by the new cryogenic systems, and low-temperature oxygen containers in which liquid oxygen is stored under controlled pressure and temperature and vaporized at customer locations.

Inlet connections

Prior to World War II, the same cylinder valve thread connection used on oxygen cylinder valves was also used on cylinders designated for use with water-pumped compressed air, water-pumped nitrogen, water-pumped argon and water-pumped nitrogen gases.

During the war, the Compressed Gas Association created a new set of standards for use by the Allied Forces.

These new standards: provided non-interchangeability between gases which were incompatible with respect to each other, differentiated between fuel gases and inert gases, and isolated oxygen from any possible interchangeability with any other gases.

The specification for oxygen connection is CGA 540. The male thread for the cylinder valve outlet is known as CGA 541 and is described as 0.903-in.-14 NGO-RH-EXT. The mating inlet connection which connects the regulator to this cylinder valve is known as CGA 542 and consists of a tailpiece having a rounded nose and a connecting nut with the mating female 0.908-in.-14 NGO-RH-INT thread. This provides a tolerant clearance between mating threads of 0.005-in.

No other cylinder valve connection employs this thread dimension or form either internal or external, right-hand or left-hand form, for any gas. Thus, there is insurance against accidental interchange of oxygen equipment with equipment intended for other gases.

This further insures against interchange and misuse of regulators which may have become contaminated by traces of oil film resulting from their prior use on gases incompatible with oxygen.

Basic regulator types

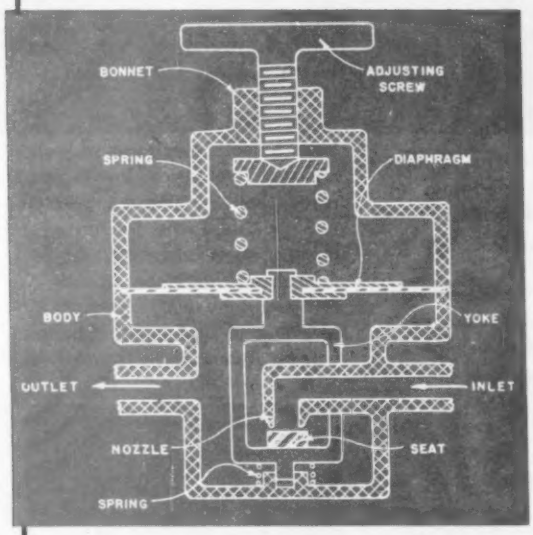


FIG. 1: Nozzle-type single-stage regulator.

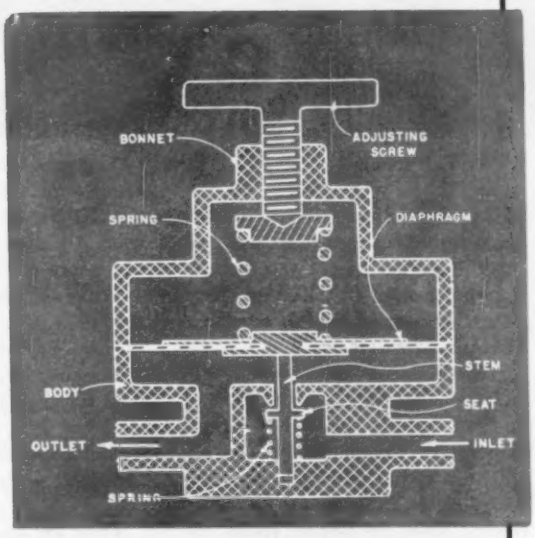


FIG. 2: Stem-type single-stage regulator.

The two basic regulator types are:

Nozzle type (positive) — (See Fig. 1) The valve nozzle faces downstream in the direction of flow. Incoming high-pressure gas exerts a force against the nozzle area tending to push the seat disc off its contact with the nozzle. Hence, as inlet pressure progressively diminishes in the supply container, this force progressively diminishes and delivery pressure declines as the container pressure becomes less and less. In certain types of welding equipment, this is a highly desirable characteristic. Since the decline in oxygen delivery pressure will immediately manifest itself by producing a carbonizing characteristic in the oxyacetylene flame, the operator is warned of the necessity for readjustment in positive pressure torch designs.

Stem type (negative) — (Fig. 2) The nozzle is turned about to face the opposite direction to gas flow and a stem projects through this nozzle to attach to the seat disc. The high-pressure gas comes from behind the seat and exerts a force trying to push the seat closed. Thus, as the container pressure diminishes, this force becomes less effective and the result is a tendency of delivery pressure to rise to a higher value. This is considered to be more desirable, in the opinion of many, when used with semi-injector and full-injector type torch designs.

OUTLINED against the sky, welder puts finishing touches on aluminum liquid oxygen storage tank for Colorado Fuel & Iron Corp.'s on-site oxygen plant.

At normal temperature and pressure, gaseous oxygen occupies 862 times the space it does as a liquid. Hence, the economies of shipping and storing it as a liquid are obvious

Nickel steels, aluminum compete for growing cryogenic market

by **F. T. Tancula**

CONTAINERS FOR STORING and shipping liquid oxygen (as well as other liquefied gases) represent a growing market . . . and one that is getting a great deal of attention from metal producers.

The demand for cryogenic liquids in growing quantities has spurred efforts like the recent "Operation Cryogenics."

The material demonstrated: 9% nickel steel. This metal is not new, having been developed about 15 years ago. But Pressure Vessel Code requirements call for a container fabricated from 9% nickel steel to be stress relieved.

The demonstration late last year showed that this requirement may be unnecessary. Burst and impact tests well above service requirements indicated that a quenched and tempered 9% nickel steel in the as-welded condition exhibits low-temperature notch toughness equal to that of the currently used double-normalized and tempered metal.

The tanks that underwent these tests were field welded and required no special positioning. However, a preheat of 200 F resulted in a more stable arc.

Whether steel companies found that their arch rival — aluminum — necessitated this demonstration is a moot point. But it is obvious that for cryogenic service in the —150 F to —320 F range, two weldable aluminum alloys — 5083 and 5086 — have made inroads.

These are aluminum-magnesium-manganese alloys of high strength, but they possess the excellent welded ductility characteristic of other alloys in the 5XXX series.

The stainless steels, especially type 304, still have the largest share of the market for containers subject to temperatures lower than —320 F. Nevertheless, at least one aluminum tank has been built for storing liquid hydrogen, which must be kept at a temperature of —423 F. As one aluminum spokesman put it, "9% nickel steel wants in where aluminum is used; while aluminum wants in where the stainless steels are dominant."

Actually, copper was the most widely used material for early low-temperature work. One of the more successful alloys in such service is silicon bronze containing 3% silicon and 1% manganese.

Cost comparisons of the larger structures for storing liquid oxygen are readily available, but they give different pictures. As might be expected, it all depends upon who is making the comparison.

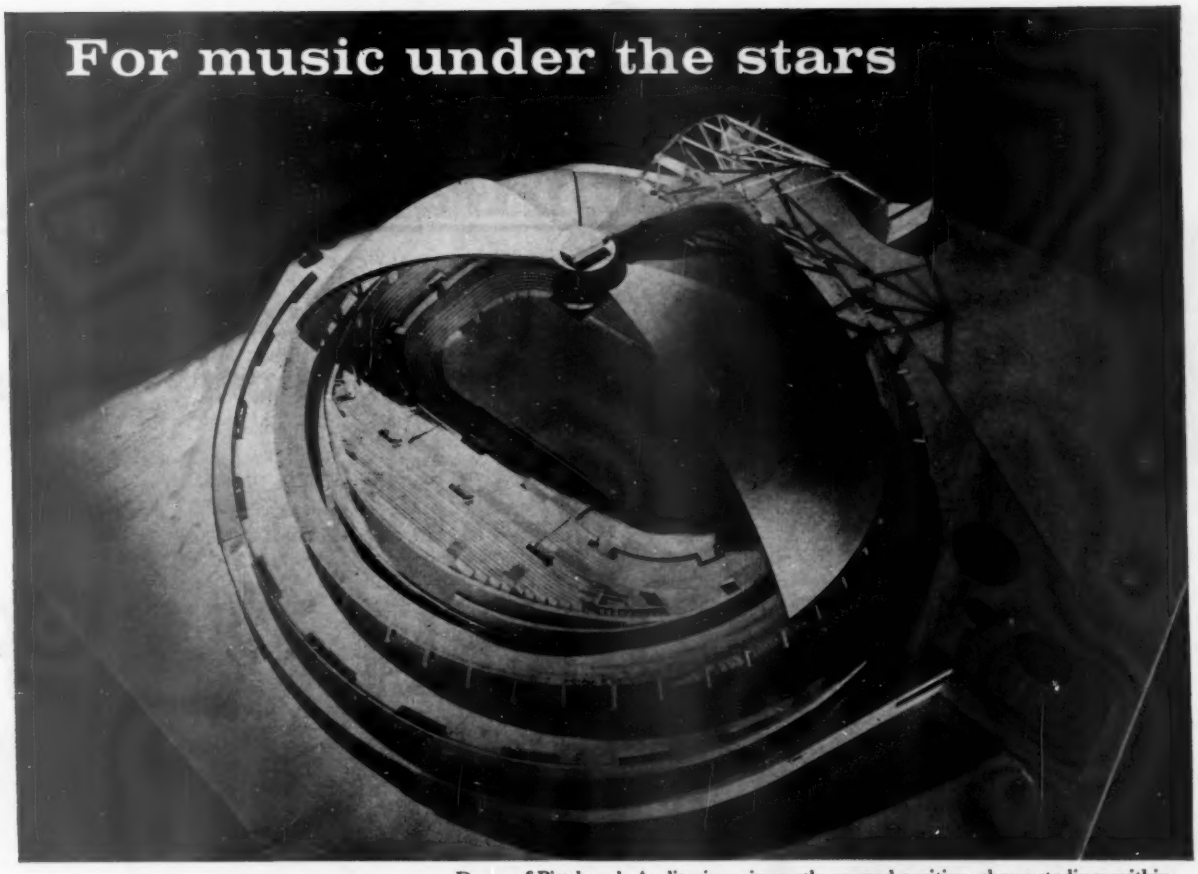
One thing all the competing materials must have in common: good weldability and the ductility so necessary for low-temperature service. There is always a reasonable concern that these high-strength materials may be subject to brittle fracture under certain conditions.

That is the reason a notched specimen must be used in ductility tests. Smooth specimens may show amazing ductility at low temperatures, but a notched specimen may fail in brittle fracture — indicating its notch sensitivity.

Welding data on metals for cryogenic service, especially 9% nickel steel and 5083 aluminum, will be presented in future issues.

ENGINEER makes final check before 9% nickel steel pressure vessel, filled with —320 F liquid nitrogen, is burst tested.

For music under the stars



Dome of Pittsburgh Auditorium, in partly opened position, shows stadium within.

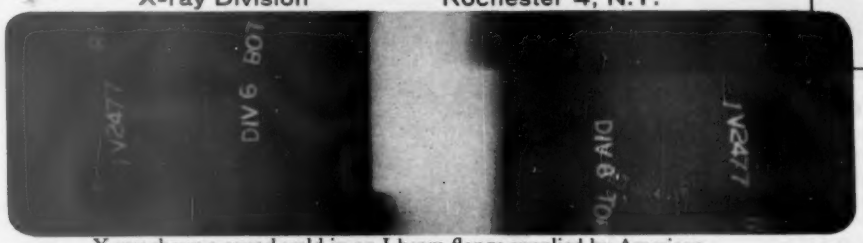
The 400-foot rollback dome of the new Pittsburgh Auditorium is supported by one huge welded cantilever backwork. Welds were proved sound by radiography.

The "leaves" of the great dome over Pittsburgh's new auditorium move on a circular track turning on an overhead pivot. There are no interior supports. When the dome swings open, the anchors of the backwork holding it up are under about 4,000,000-lb. tension, the buttress under 7,000,000-lb. thrust. Every weld in the system is critical.

To assure the integrity of all welds, U.S. Steel's American Bridge Division radiographed them using Kodak Industrial X-ray Film. This radiographic inspection provides a permanent record of the soundness of the welds.

If you would like to learn more about radiography in terms of your business, talk it over with an x-ray dealer, or write us for a Kodak Technical Representative to call.

GOOD NEWS! Kodak Industrial X-ray Film, Type AA and Type M, is now available in the new, convenient Ready Pack. Each sheet—sealed in a light-tight envelope ready for exposure—stays clean. After exposure a rip strip on the envelope makes it easy to open in the darkroom.



X-ray shows a sound weld in an I-beam flange supplied by American Bridge Division of the United States Steel Corporation.

EASTMAN KODAK COMPANY
X-ray Division Rochester 4, N.Y.

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NEW FROM *Linde*...

First photocell tracing system

...follows simple pencil drawings on ordinary paper!

THE LINDE TRADE-MARK PHOTOCELL TRACER

Here is the all new OXWELD CM-56 dual-carriage shape-cutting machine. It can carry more torches over a wider range than other similar sized and even larger machines. The 90-in. model (shown here) carries up to 6 torches; the 120-in. model up to 8 torches; 62-in. model up to 4 torches. A new cross roll drive principle takes the drive wheel completely off the tracing table. All operating controls are grouped on a conveniently located panel.

with built-in kerf adjustment!

Exact size pencil drawings of the most intricate shapes and forms can now be used to guide oxygen shape-cutting machines! Using easy-to-prepare pencil or ink drawings on ordinary paper, you entirely eliminate expensive and bulky templates, photographic negatives and costly silhouettes. And there is no template storage problem. In most shops, savings from the elimination of templates alone will pay for the new tracer in less than a year.

Extreme Accuracy—Tracer accuracy is excellent—within ±0.005 inch. Kerf widths up to ¼ in. are adjusted for on the tracer. Drawings of parts are made in the *exact size* of the piece desired. They can even be traced directly from engineering drawings! With LINDE's unique kerf adjustment, one simple line drawing can be used to reproduce the same shape in different plate thicknesses.

Speed is controlled by an efficient eddy-current governor that provides smooth, stepless speed control over a range adjustable from 2 to 30 in. per minute. The tracer can negotiate 90° turns with 1/16" radius at average cutting speeds. Models of the new tracer are available for use with all OXWELD machines and most competitive machines.

Tracer not affected by ambient light—The Tracer may be located indoors or outdoors without regard for lighting conditions. Ordinary light or sunlight does not interfere with the precision operation of the tracer. An operator can use as much light as he needs to follow the cutting operation without fear of upsetting the cutting pattern. He can steer manually or use remote control buttons.

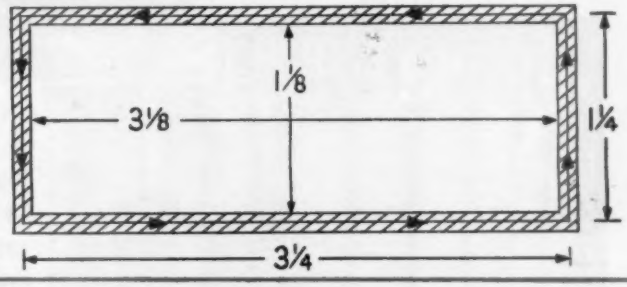
Get full details on the new LINDE Photocell Tracer and the OXWELD CM-56 shape-cutting machine from your local LINDE office. Or, write Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. In Canada: Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

LINDE COMPANY UNION CARBIDE

WHAT KERF ADJUSTMENT MEANS TO YOU:

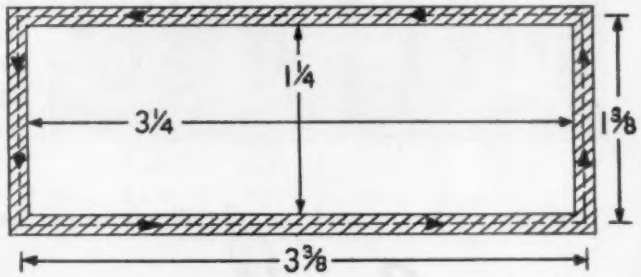
Cutting without kerf adjustment

Path of torch guided by a tracer without kerf adjustment following a 1¼" by 3¼" drawing. Assuming the kerf width is ⅛" the actual part produced measures only 1⅛" by 3⅛" even though the torch (arrows) faithfully follows 1¼" by 3¼" drawing.



Cutting with kerf adjustment

Path of a torch guided by LINDE Photocell Tracer with kerf adjustment following a 1¼" by 3¼" drawing. With the kerf adjustment set for the ⅛" kerf the torch (arrows) will follow a path 1/16" around the outside of the 1¼" by 3¼" drawing of the part. Actual shape produced measures 1¼" by 3¼"—exactly the same as the drawing.



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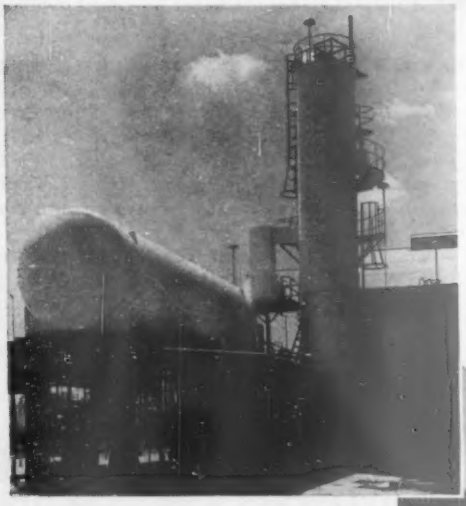

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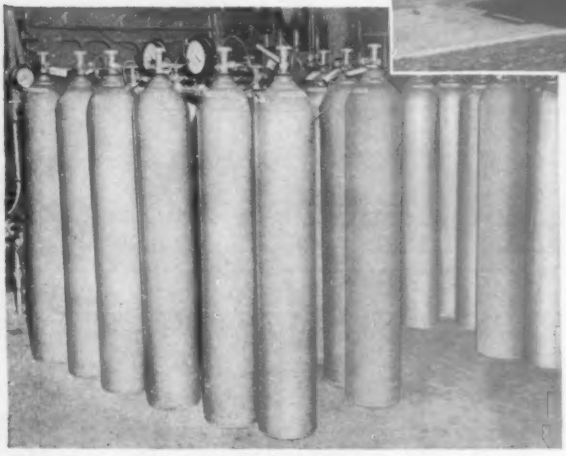

Southern Oxygen Company, manufacturers of compressed gases for industry and medical therapy since 1916, produces high purity argon in both liquid and gaseous form. Southern's bulk liquid storage and cylinder charging stations are strategically located in industrial areas from the eastern seaboard to Dallas, Texas, and Kansas City, Missouri. Our engineers can give you process information and qualified technical assistance at no charge. This is all part of our Customer Service policy.

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OXYGEN CYLINDER DATA

Capacity Equivalents

The following data will be helpful in determining oxygen cylinder capacities:

9.32 cu in. cylinder volume is required for 1 cu ft of free oxygen when stored at 2,400 psi and 70 F.

11.86 cu in. cylinder volume is required for 1 cu ft of free oxygen when stored at 2,015 psi and 70 F.

28.35 cc equals 1 fluid ounce.

16.39 cc equals 1 cu in.

453.6 cc of water weighs 1 lb.

27.737 cu in. of water (at 60 F) weighs 1 lb.

1 cu ft equals 7.48 gal or 28.3 liters.

1 gal equals 3.785 liters or 0.132 cu ft.

1 liter equals 0.264 gal or 0.035 cu ft

Oxygen-density per cu ft	**0.08279**
Specific gravity at −181.8 F	**1.14**
Melting point	**−361.1 F**
Boiling point	**−297.3 F**
Critical temperature	**−181.8 F**
Critical pressure (49.7 atm.)	**715.88 psig**
Approx. cylinder filling pressure @ 70 F	**1,650-2,200 psi**

Oxygen Cylinders

Standard Weight — ICC 3A Specification — Manganese Steel

Capacity	Pressure, psi		Dimensions, in.				Weight, lb	
in cu ft	Working	Test	ID	OD	Wall	Length[1]	Empty[2]	Full
55	2015	3360	5	5 27/64	0.210	41½	47½	53
55	2015	3360	5½	5 29/32	0.200	37½	42½	48
55	2015	3360	6⅝	7 1/8	0.250	29¼	42½	48
80	2015	3360	6⅝	7 3/32	0.230	38	63½	70
80	2015	3360	6⅝	7 1/8	0.250	35½	59½	65
110	2015	3360	6⅝	7 3/32	0.230	48½	73½	83
220	2015	3360	8½	9 1/16	0.280	56½	132½	152

Light Weight — ICC 3AA Specification — Chrome Molybdenum Steel

Capacity	Pressure, psi		Dimensions, in.				Weight, lb	
in cu ft	Working	Test	ID	OD	Wall	Length[1]	Empty[2]	Full
55	2015	3360	5	5 3/8	0.190	42½	42½	48
55	2015	3360	5½	5 23/64	0.180	37½	39½	44
55	2015	3360	6⅝	7	0.190	29½	36½	42
80	2015	3360	6⅝	7 3/64	0.205	35½	55½	63
80	2015	3360	6⅝	7	0.190	38½	54½	62
110	2015	3360	6⅝	7	0.190	48½	66½	76
125	2265	3775	6⅝	7 3/64	0.205	48½	72½	84
150	2015[+3]	3360	7	7 13/32	0.205	52	80½	92
220	2015	3360	8½	8 61/64	0.230	56½	111½	131
250	2265	3775	8½	9	0.250	56½	122½	147
300	2400	4000	8¾	9 19/64	0.270	60½	141½	170
400	2400	4000	10	10 5/8	0.310	61½	194½	233

1—Including cap of 5½ in.
2—Including cap (3 lb) and valve (1½ lb).
3—Plus allows 10% increase in working pressure (to 2265 psi) if properly valved.

Cylinders of these types are manufactured by Harrisburg Steel Co. and Taylor-Wharton Co., divisions of Harsco Corp., and by Pressed Steel Tank Co., and Marison Co.

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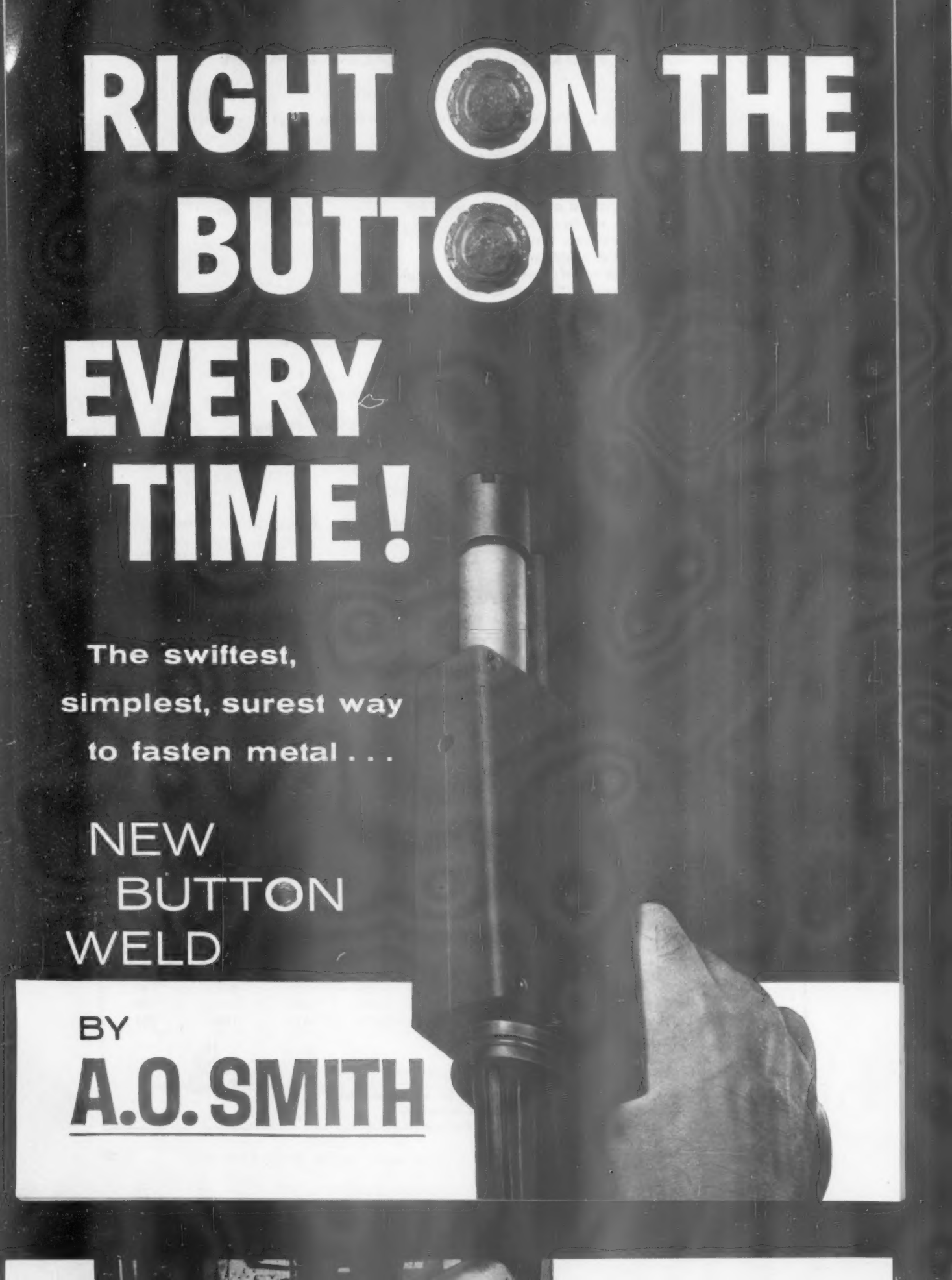
BY

A.O. SMITH



C-OMANUAL button welding boosts output . . . cuts rejects

Here's one button the zipper hasn't replaced. In fact, this button process is the latest development in welding — a development that has replaced old-fashioned spot-resistance welding and riveting.

Armed with a lightweight hand gun using A. O. Smith's CO_2 C-OMANUAL process, the operator works from one side only. The button burns through to fasten steel up to 3/16 in the downhand position and 3/64 in the vertical. And welders take their helmets off to button welding — no need to wear one with this A. O. Smith process. Simple, too! Special operator training is not required. Just place the gun . . . pull the trigger! Hold until the welding stops *automatically*. Perfect button weld every time . . . no flux to clean.

Choice of nozzles permits welding of any of the standard joints (lap, fillet, butt).

Timed fillet button weld | Typical Burn-thru button weld | Burn-thru button weld — light-gage

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WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin

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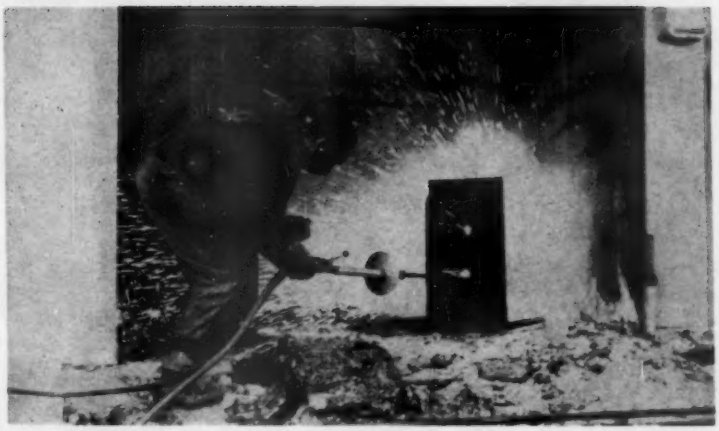


POWDER-LANCE, operated by Hill Air Force Base weldor, throws off a shower of sparks as it burns through 18-in. thick reinforced concrete.

Powder-lancing cuts 18-in. concrete doorways

CUTS IN CONCRETE up to 12-ft thick can be made with an oxygen-powdered metal process called powder-lancing.

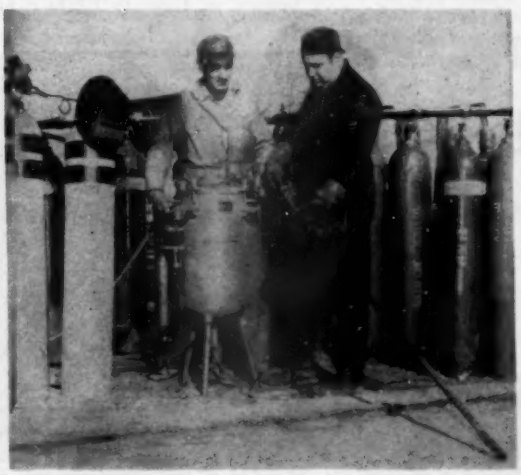
The process, developed by Linde Co., New York City, was used recently to cut doors in 18-in. thick reinforced concrete walls of an engine test building being converted for additional maintenance facilities at Hill Air Force Base, Ogden, Utah.

In powder-lancing a special mixture of iron and aluminum powder is fed pneumatically through lengths of black iron pipe fitted into a lance handle and mixed with oxygen. The lance is manually operated and consists of a lance handle with one or more lengths of consumable black iron pipe attached.

Powder and oxygen are mixed in the pipe ahead of the lance handle, carried to the cut by the pipe, and ignited to produce intense heat to melt the concrete.

On the Hill project, a single operator with a powder-lance cut a 10-ft by 10-ft doorway in the thick walls in an 8-hr day. Jackhammer crews required 10 days to cut an identical opening.

Powder-lancing operations at the Utah base consumed an estimated 3,660 cfh of oxygen and 100 lb of iron-aluminum powder per hour. Black iron pipe, ½ in., used in 18-ft lengths was expended at 1 ft per in. of concrete cut.



OPERATORS make final adjustments before firing up powder-lance to demolish concrete walls.

METALLURGIST removes diffusion bonded sample from tube furnace where copper parts are joined in hydrogen atmosphere.

Diffusion bonding, brazing join copper parts

Cost savings, easier production methods and improved products are among the advantages which may result when . . .

COST SAVINGS, EASIER PRODUCTION methods and improved parts are a few advantages claimed for a new technique of diffusion bonding and brazing copper parts.

In the process, developed by Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corp., Waterbury, Conn., a homogeneous bond as strong or stronger than the base metal is produced to join two or more copper components.

A special coating on the metal surface diffuses into the parts to be joined and, under proper conditions, produces a bond without interface. Joints made in this manner retain virtually all of the high electrical and thermal conductivity of copper.

This retention of conductivity makes the process especially advantageous for many electrical and electronic applications.

In the process, fabricated and coated parts are diffusion bonded by heating at 1,700 to 1,800 F in a hydrogen or inert atmosphere for a short period — ordinarily 5 to 15 minutes. The carrier volatilizes during this exposure and is dissipated in the furnace atmosphere. Reasonably good contact of the mating surfaces to be joined is required.

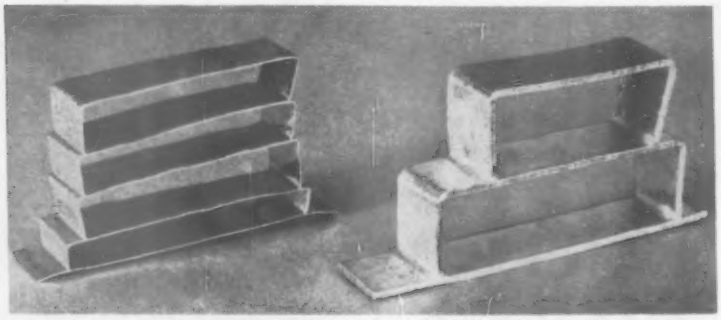
Tests on such diffusion-bonded joints have shown them to be superior to soft-soldered joints in respect to tensile, shear and fatigue properties.

The coating which effects diffusion bonding of fabricated parts can be applied to copper strip before it is rolled to finished gage. Diffusion, braze and combined diffusion and braze bonds are all possible with the process.

In its present stage of development, the diffusion bonding process has certain limitations including the fact that after exposure at bonding temperature, base metal is in a fully annealed condition with characteristic mechanical properties.

Some applications may permit subsequent mechanical working, such as coining or internal expansion, to increase hardness and tensile properties. In other cases, this may not be necessary since only physical properties which are not adversely affected by the bonding treatment will be essential.

To date, true diffusion bonds have not been achieved with brass containing more than 5% zinc. However, satisfactory braze-type joints have been obtained when the diffusion bonding technique has been applied to brasses with zinc content up to 30%.



DIFFUSION BONDED assemblies illustrate the joining of parts where only one surface has been coated. Strip surface was coated with bonding agent, but no coating was applied to edges. These are edge-to-surface joints. Strip in left assembly is 0.005-in. thick. Strip in right assembly is 0.025-in. thick.

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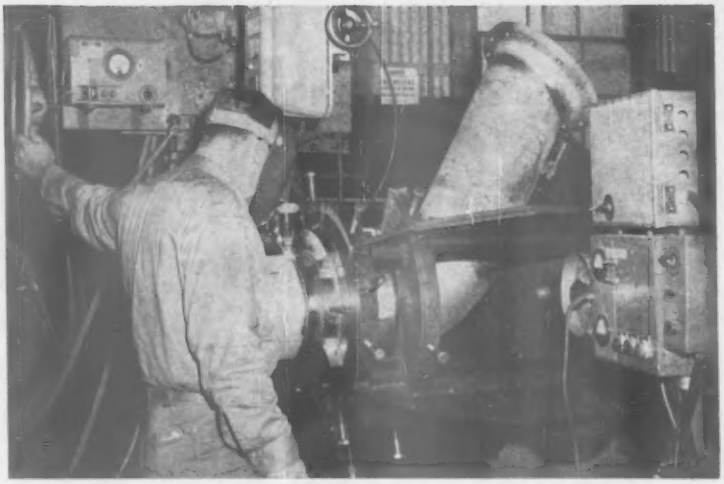

AUTOMATIC Tig setup in action at Tyce Engineering Corp. Circumferential welds are made in ⅜-in. stainless steel at 10 ipm.

Tig welding cuts costs 50% in oxygen line fabrication

More than 50% savings in welding costs are being realized by Tyce Engineering Corp., Chula Vista, Calif., in the fabrication of high-pressure liquid oxygen lines for Atlas ground support equipment.

The company recently replaced manual welding methods with automatic Tig equipment manufactured by Linde Co., New York City, and found production boosted considerably.

In this application, circumferential butt welds are made in ⅜-in.-thick type 321 stainless steel measuring 10 in. in diameter. Automation is obtained by mounting a torch on an automatic welding machine and rotating the workpiece with a special turning device. Current setting is 15 volts, 80 amp, d-c, straight polarity.

Welds are made in all flanges and flexible joints at 10 ipm using stainless steel wire with an argon gas backup. A total of six passes is required for each circumferential weld. Each joint is subjected to rigid testing by X-ray, or fluorescent inspection.

According to Tyce, the outstanding feature of the company's new Tig installation is an automatic device built into the welding head that compensates for eccentricities of alignment of the workpiece.

This device maintains a constant voltage setting despite surface irregularities by automatically raising or lowering the welding head as such irregularities are encountered.

QUALITY control manager Jim Copely (left) and welding engineer Leonard Musil check one of completed components for high-pressure liquid oxygen line.

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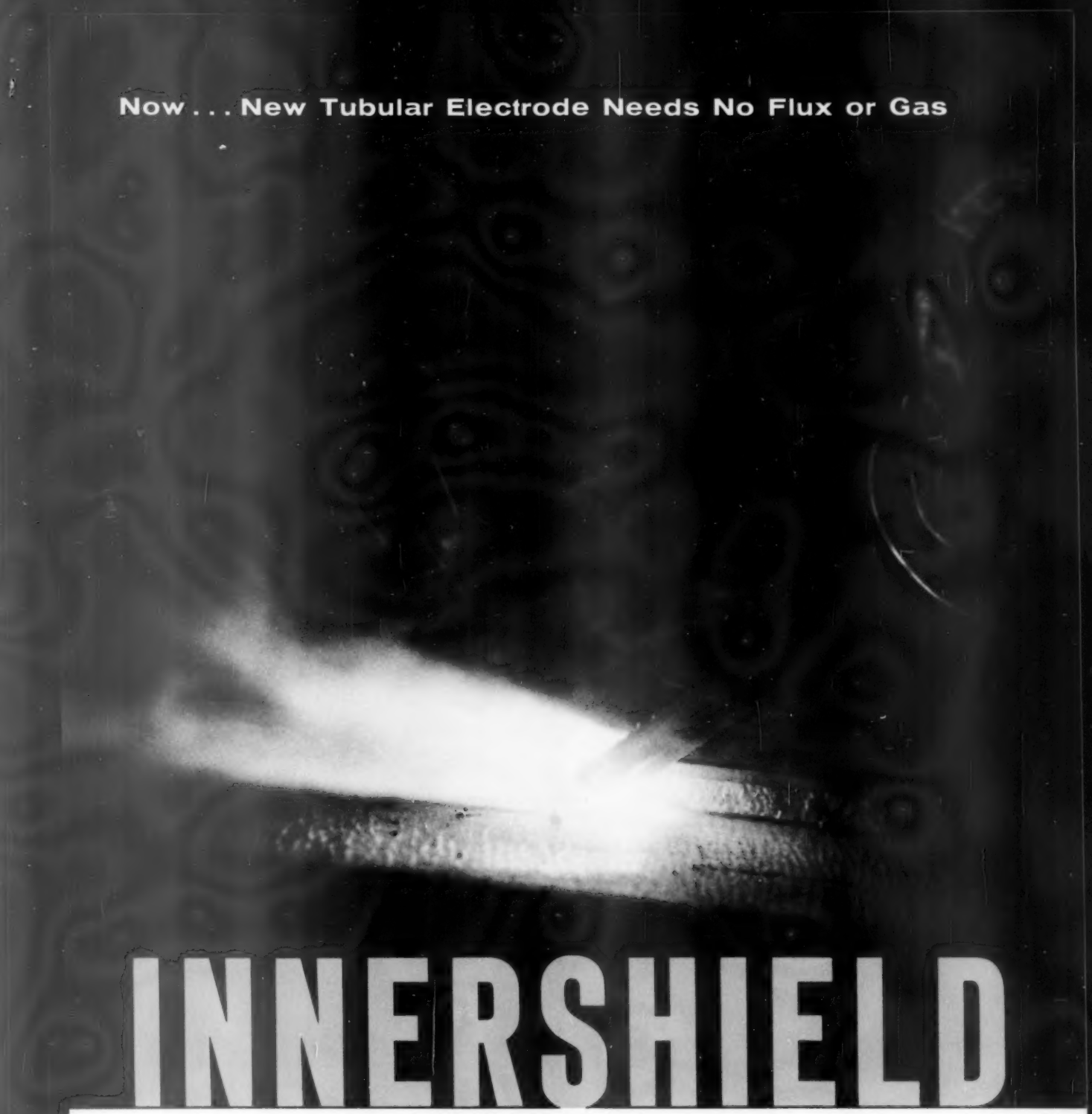
Now . . . New Tubular Electrode Needs No Flux or Gas



INNERSHIELD

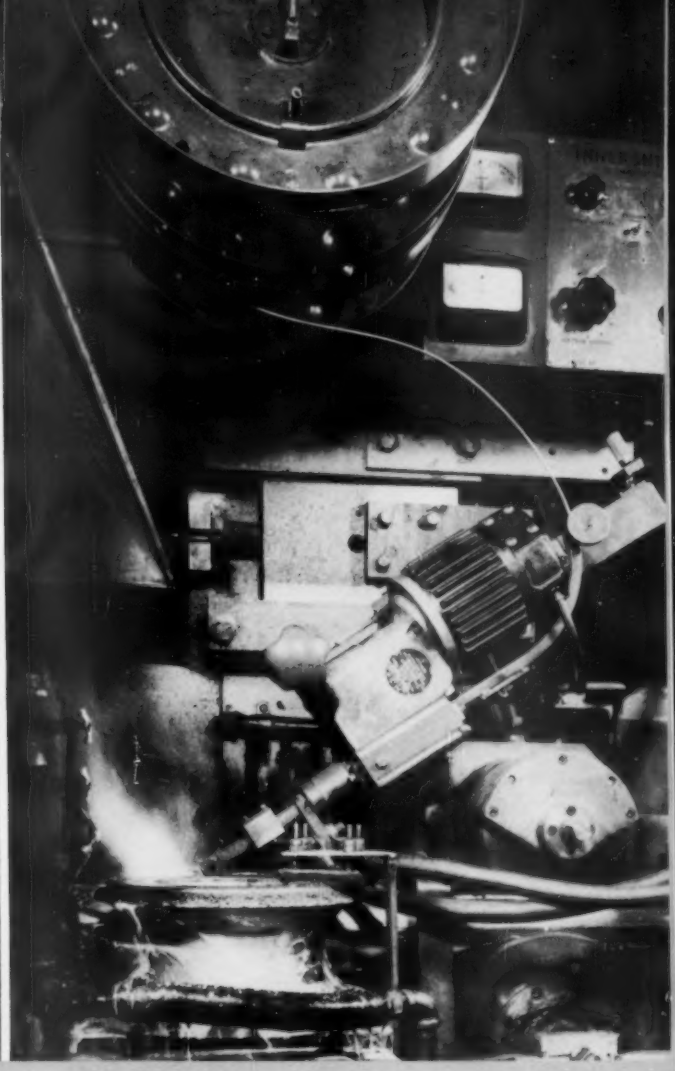
Lincoln's dramatic new welding process–Innershield–uses a special tubular electrode containing all necessary ingredients for welding–filler metal, arc shielding, deoxidizers, fluxes. Needs no CO_2, Argon or granular flux. Two new welders use it–a full-automatic and a semi-automatic called Squirt.

Welding railroad car center sills is easy, fast. The highly efficient, dense and chemically inert conical arc shield is virtually impenetrable by the surrounding air. Welds are sound, stronger than base metal. Visible arc lets operator follow joint easily. Speeds up to 50 ipm possible.

Innershield Squirt is ideal for short, intermittent, single-pass welding on parts such as these building trusses. Innershield electrodes bridge gaps caused by poor fit-up; medium penetration avoids burn-through. Excellent for diversified job shop operations.

THIS IS INNERSHIELD ON THE JOB

Because Innershield Squirt is flexible, easy to use, it replaces manual methods for welding small parts set up in jigs and fixtures. On this job, it increased welding speed by 150%, decreased slag cleaning time, and significantly reduced cost of finished parts.



Here, full-automatic Innershield makes continuous butt weld on 4-inch tubing at 120 ipm. Special electrode eliminates flux used in submerged arc process as well as manifold and piping systems needed for inert gas process. Reduces inventories, purchasing problems, storage space required.

Innershield Squirt is incomparably faster than manual welding both in deposit rate and arc speed. Deposition efficiency is an excellent 85% as contrasted with about 65% for hand welding, 50% for submerged arc. And because there's no stopping to replace electrodes, operating factor is extremely high.

Innershield Squirt is easy to use, too. Even an amateur can pick up the gun and turn out professional welds in ten minutes. We've illustrated (above) a few of the applications where Innershield Squirt is already on the job stepping up production, cutting costs . . . in the job shop as well as on high volume production lines.

See Innershield At Work

Somewhere near you there's probably a Squirt unit at work boosting production, cutting costs. Why not have your Lincoln Field Engineer show it to you? Send in the attached postcard today. And, for a complete description of the Innershield process, available electrodes and both semi-automatic Squirt or full-automatic equipment, ask for your copy of Bulletin 5300.1.

HERE'S THE GUN THAT LETS AN AMATEUR TURN PRO

Pull the trigger, strike the arc, and you're welding faster than ever before. This gun, made of tough molded plastic, needs no water cooling, is light in weight, and is easy to handle. You have to try it to believe how easy it is to make tough, sound welds . . . fast!

MN-1—RUGGED, COMPACT INNERSHIELD SQUIRT WELDER

Here's a compact, sturdy unit designed and built to hold up under rough on-site conditions. It's not finicky. Put it to work in your shop, shipyard or production line, now! Comes complete with wire feed mechanism, wire reel, input and output cables, gun and controls.

LINCOLN WELDERS

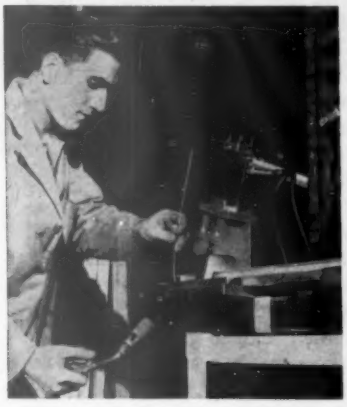
THE LINCOLN ELECTRIC COMPANY
22801 St. Clair Avenue
Cleveland 17, Ohio

Fluxless solder cuts aluminum window costs

by **Clyde James**
All-State Welding Alloys Co. of Canada, Ltd.

ASSEMBLY TIME and production costs for aluminum window frames were cut sharply when a Canadian manufacturer substituted soldering for mechanical joining.

T. J. C. Home Products Ltd., Ontario, originally joined its frames for storm windows and screens with eight screws per window. This required an average assembly time of 1¼ minutes per corner, or five minutes per window. Total cost for each window frame was 32 cents.



The manufacturer redesigned the frames to make use of an aluminum stick solder made by All-State Welding Alloys Co. The fluxless, rub-on type solder can scrape through surface oxides and produces bonds up to 20,000 psi tensile.

With the aluminum solder, assembly time was reduced to three minutes per window and costs were lowered to only eight cents.

Aluminum shapes are cut to length and clamped in position. Propane torches are used to heat the frame corners with a carbonizing flame. (Oxyacetylene or any other torches can be used also.)

When the temperature reaches 720 F, the solder is then quickly rubbed on. After the window has been cooled, it is stress relieved. Color match is nearly perfect.

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VAPOR SHIELDING PROCESS CUTS WELDING TIME

A NEW SEMIAUTOMATIC vapor-shielded arc process is doubling welding speeds on jobs previously manual metal-arc welded.

Typical welding speeds for the new Innershield process for 5/16-in. fillets on 63-ft longitudinal flat center sills are 23 ipm compared with 12 ipm when regular stick electrodes are used.

The process, developed by The Lincoln Electric Co., Cleveland, uses a new electrode combined with a hand-held welding gun which is continuously fed wire and current.

Two outstanding features claimed by the company are:

1 — Unusually high welding speed.

2 — Complete absence of any type of externally introduced shielding or fluxing material.

The process has been used for several years in specialized fully-automatic high-speed applications. Development of a "fast fill" electrode in conjunction with a welding gun and wire feed mechanism now extends its use to semiautomatic applications.

The basic principle behind this welding process is vapor shielding achieved with a tubular, fabricated electrode. The mild steel tube provides filler metal and contains materials which furnish all necessary ingredients for shielding, deoxidizing and fluxing.

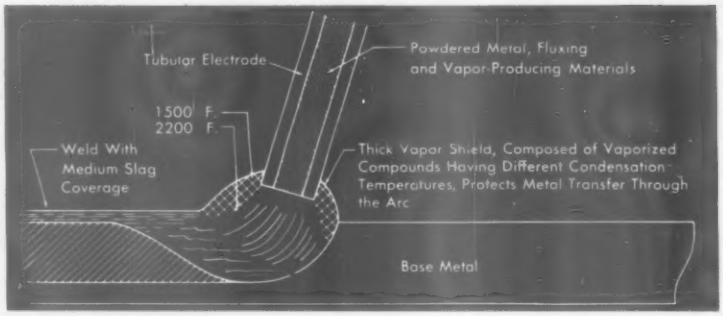
The materials in the vapor-tube electrode include metallic salts and oxides which:

√ **melt at temperatures lower than the melted electrode metal.**

√ **boil and produce vapor at a temperature lower than the melted electrode metal.**

√ **are chemically inert.**

Here is how it works


Tubular Electrode
Powdered Metal, Fluxing and Vapor-Producing Materials
1500° F.
2200° F.
Weld With Medium Slag Coverage
Thick Vapor Shield, Composed of Vaporized Compounds Having Different Condensation Temperatures, Protects Metal Transfer Through the Arc
Base Metal

Introducing these metallic salts into the intense heat of the arc causes them to vaporize and expand. As they reach the isothermal cone, they surround the arc, which corresponds to their condensing temperature. They then recondense to form a relatively thick vapor shield around the arc and molten metal preventing contamination by the surrounding atmosphere.

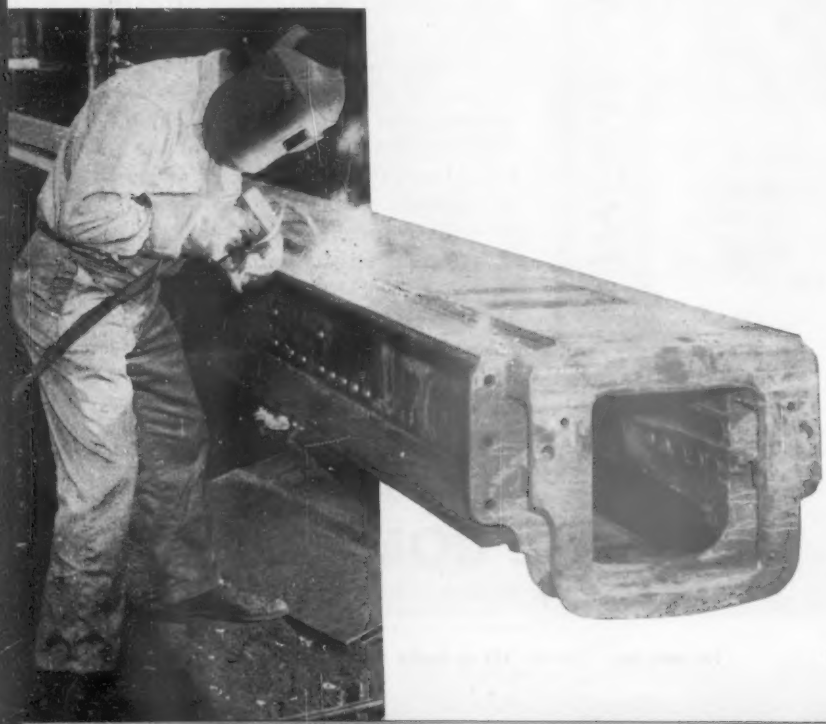
Equipment for the process is compact and simple to operate. A wire feed mechanism, containing wire reel and drive rolls, feeds the wire and current through a cable to the welding gun. The gun is little more than a nozzle with an actuating trigger and pistol grip.

To operate, the weldor pulls the trigger which starts the welding current and wire feed. He then moves the gun along the seam to be welded and releases the trigger when he wishes to stop welding.

The main components of the center sills fabricated by this process by Thrall Car Mfg. Co., Chicago Heights, Ill., consist of two 132-lb-per-ft CB-301 I-beams and a 3/4-in. by 13-in. cover plate.

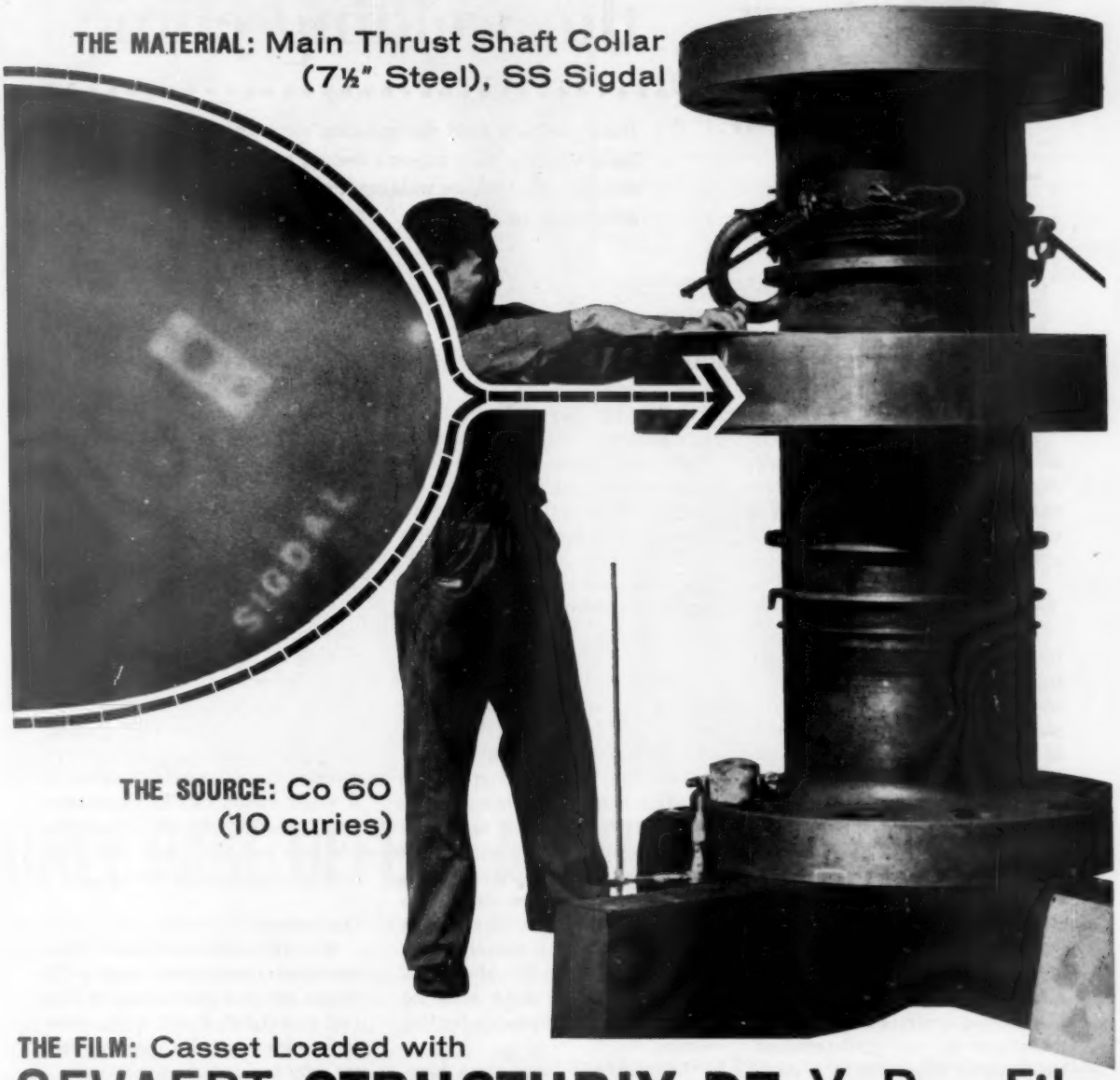
Before welding, the I-beams are tapered at both ends to achieve weight economy while maintaining necessary rigidity. The weldor then deposits 125 ft of 5/16-in. horizontal fillets to join these beams into structural sections.

Using 550 amp and 33 volts d-c to deposit the 0.115-in. diameter NS-3 electrode, Thrall cut welding time from 125 to 64 minutes.



THE TEST: Radiographic Examination, Todd Shipyards Corp. (Bklyn. Div.)

THE MATERIAL: Main Thrust Shaft Collar (7½" Steel), SS Sigdal



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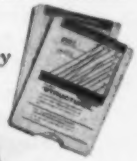

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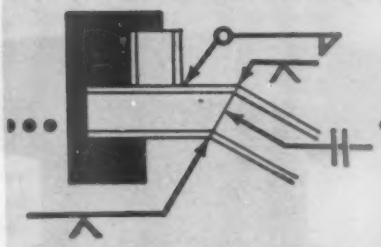


the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Basic principles of induction heating explained

Question:

All the articles I have read on induction heating relate the benefits of the process, but none explained the principle on which it works. Could you provide me with a brief description?

Answer:

Induction heating may be defined as the raising of a material's temperature by the electrical generation of heat within that material and not by any other method such as convention, conduction or radiation.

It is essential that the material being heated should not be a part of any closed electrical circuit supplied from a source of electrical energy, as is the case with resistance heating.

Induction heating will produce a fast, localized heat that is capable of being controlled within close limitations to any predetermined temperature. Moreover, it is readily adaptable to mass production.

Installations now operating in production lines consistently produce high quality joints at greatly increased speeds.

The process of induction heating is a phenomenon caused by an alternating magnetic field. Such a field occurs in the area surrounding a conductor carrying an alternating current, and the reversals of the magnetic field follow those of the current in the conductor.

Magnetic material, if placed within this type of field, is heated by both hysteresis (that is, magnetism's tendency to lag behind the current that produces it) and by the eddy current losses.

Hysteresis loss is caused by molecular friction within the materials and the magnitude of the loss is directly proportional to the frequency of the magnetic field. Eddy current losses, on the other hand, are resistance losses resulting from small circulating currents within the material.

This loss is proportional to the square of the frequency and the square of the current flowing in the field-producing conductor.

Induction heating is applicable to either magnetic (ferrous) or non-magnetic (non-ferrous) materials. The heating of non-ferrous material depends solely on eddy current losses. And since non-ferrous metals' resistance is usually less than that of ferrous metals, loss is comparatively small. Hence, a stronger magnetic field must be used to obtain comparable heating results.

Eddy current losses are a function of the frequency of reversal of the magnetic field, which is determined by the frequency of the current flowing conductor. Thus, high frequencies are necessary.

There are three available sources of electrical energy at frequencies and capacities suitable for commercial induction heating: the rotating electrical generator; the resonant spark-gap circuit; and the vacuum tube oscillator. These sources cover a frequency range from 1,000 cycles to 5 megacycles, and each has its inherent advantages and disadvantages.

After obtaining a source of high frequency electrical energy by any of these methods, the next problem is design of a conductor setup which will give the proper heat producing magnetic field.

Since the prime purpose of using induction heating is to localize heat to a certain specified section, we must produce a magnetic field meeting these requirements and having sufficient field strength to give the desired heating effect.

The usual form of these conductors is a coil, which may be either single or multi-turn. Because field strength depends on the current in a single conductor, its magnitude is amplified by the use of a multiple turn coil since each turn acts individually as a conductor.

Question:

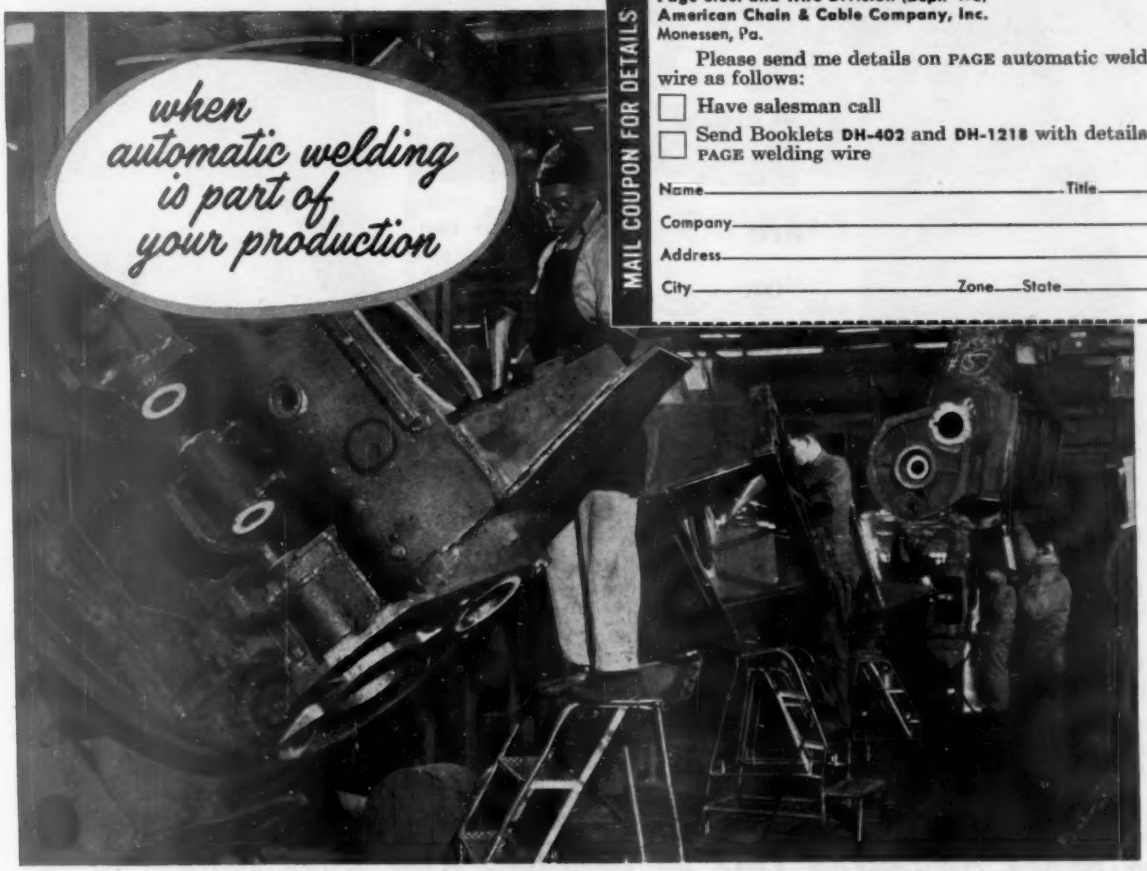
We Tig tack-weld small 6061 *aluminum components using a* 5% *silicon rod. But when they are dipped in a* 1,048 *F salt bath, some tack welds fracture. Could you tell me why and is there a solution?*

Answer:

When you use a 5% silicon rod for tack welding on 6061 aluminum, you are using a material that probably gets "mushy" at the 1,048 F temperature of the salt bath. This rod also has a hot-cracking tendency, hence the fracturing.

You should use a 5356 aluminum welding rod which has a melting temperature close to that of 6061 aluminum, and does not have the hot-cracking tendency.

The welds produced will not have as nice an appearance and there is a tendency to spatter, but it will provide the desired results.



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The wire that meets your production needs • Good automatic welding demands these two wire qualities: a wire analysis which gives the best match to the metals to be welded, and wire uniformity. You get both when you use PAGE welding wire. From a full 33 analyses—the largest selection available from any manufacturer—PAGE can supply the right wire for *your* welding job. We also can develop *special* wires for particularly tough welding operations. And regardless of the wire that's best for you, you can count on PAGE uniformity—consistent metallurgical quality, accurate size, proper finish.

Coil identification to speed up production • Liner markings on each coil of PAGE welding wire provide positive identification, end mix-ups. And on #2 coils, liners are color-coded as well. The color of the stripe indicates the grade, makes identification double-quick and fool-proof.

Packaging that keeps production flowing smoothly • PAGE supplies welding wire in every form of packaging for modern production methods. You can specify PAGE wire in 25 lb. coils or reels—on up to 1200 lb. Payoff-pallets. Special packaging available when required.

GET THE COMPLETE STORY!

Mail the coupon at top—or write us describing your welding requirements. We'll be glad to help you select the right welding wire analysis and packaging for your operation.

PAGE WELDING WIRE

ACCO

Page Steel and Wire Division
American Chain & Cable Company, Inc.
Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston*, Los Angeles*, New York, Philadelphia*, Portland, Ore., San Francisco*, Bridgeport, Conn.
**Indicates PAGE warehouse stocks*

PAGE —the source for answers to welding problems

For more facts Circle No. 175 on Reader Service Card

Completed contour nose cone of 2000-lb practice bomb after elongation shows no defects at weld seam.

Welded bombs are "on target"

PLENTY OF PRACTICE bombs are needed to sharpen the eyes of U. S. bombardiers, and practice bomb fabricators deliver their production quotas "on target" with the help of modern inert gas welding processes.

At its Mendota, Ill., plant, Conco Engineering Works, Inc., manufactures contoured cones for 2,000-lb practice bombs.

Type 1020 carbon steel sheet is cut to size, rolled into a cone and welded in a jig by Linde Co.'s CO_2-Mig process.

After welding, the straight cone is stretched to shape in a form die using a contoured punch.

With previous manual metal-arc welding methods, the resulting 18% elongation caused tearing near the heat-affected weld zone. CO_2-Mig welding solved this problem through precise control of heat at the weld area. Welded seams now withstand the elongation with practically no defects.

Operating in the range of 12 to 21 volts at 30 to 125 amp, the arc short-circuits a dozen times a second, producing a welding arc with low heat input that prevents burn-through and minimizes distortion.

Carbon steel wire, 0.030-in. diameter, is used with a shielding gas mixture of 85% argon and 15% carbon dioxide. Conditions for the butt welds are 60 amp at 17 volts, d-c, reverse polarity. Manual welding speed is 16 ipm.

The Most Advanced Line of Welding Aids Ever Produced for

PIPE-LAYOUTS of ANY Type or Location

CURV-O-MARK

CONTOUR MARKERS

Marks off any pipe joint or structural angle cut accurately, easily and without figuring cutbacks. Marks all around pipe—saves time and gas. Available in 2 sizes of 1½" to 18" in cross-section, 16" to 48" diam.

CURV-O-MARK

CENTERING HEADS

Really, 5 tools in one—it replaces Protractor, Centering Head, Center Punch, Level and Scale. Eliminates difficult measuring, checking and marking. Pocket size—weight only 9 ozs.

CURV-O-MARK

RADIUS MARKERS

Has marking span of 24" and swings to 48" circle or arc. Pencil holder accommodates round or flat pencils, soapstone and steel points. Unequaled for accurate layout work. Wt. 8 oz., pocket size.

CURV-O-MARK

PIPE FLANGE ALIGNERS

For Aligning Slip-on, Top Joint, Stub End and Welding Neck Flanges. This self-centering Tool is quickly adjustable for all types of Flanges or Pipe sizes from 3" to 12" in diameter.

CURV-O-MARK

Ang-Lo-Cator Protractor

An easy way to find accurate angles on pipe and structural material. A valuable aid to weldors, structural workers and pipe fitters. Size 4" x 8"

Your Welding Supply Dealer Recommends all CURV-O-MARK Products

CONTOUR SALES CORPORATION

1843 E. COMPTON BOULEVARD • COMPTON, CALIFORNIA

OPERATOR uses 12-in. de-scaling head which develops in excess of ¼ million B.T.U.'s per hr with a flame temperature of almost 6,000 F.

Expressway beams are flame cleaned

SEEKING MAXIMUM STEEL PROTECTION, consulting engineers for a Canadian expressway recently specified flame-cleaning and dehydration.

A total of 250 8-ton 36-in. "wide flange" beams, 60 to 65-ft long, fabricated by Frankel Steel Construction Ltd. for the Frederick Gardiner Expressway project in Toronto, Canada, were flame-cleaned with equipment from British Oxygen Canada Ltd.

For the project, British Oxygen supplied 8-in. and 12-in. nozzles to clean the large steel areas. Five 300-cu-ft acetylene cylinders were coupled together for each torch. With portable liquid oxygen containers also in use, maximum work output was ensured.

In the flame de-scaling process, an intense heat was passed over the steel surface. This rapidly expanded all rust and scale adhering to the surface.

The heated scale then broke its bond to the steel and was easily removed by light wire brushing.

A second and important function of the process was that heating the steel dried out all condensation and moisture leaving an ideal paint bond surface. This adds materially to protective paint life.

MS Mid-States

SILICON POWERED WELDERS

THE MID-STATES *Sil-A-Tran*

3 PHASE DC RECTIFIER

The first 3 phase SILICON Rectifier with electric control of amperage. Has wide range of current and three position range switch with generous overlap. Reversing Polarity switch is standard equipment. *Hermetically* sealed SILICON Rectifiers prevent contamination. Non-aging characteristics of SILICON develop full power output for life of machine. High 98% efficiency of silicon cells provides smooth arc stability. Forced air ventilation and thermal safety switch prevents overheating.

200-300-400 Amp
60% Duty Cycle

200-300 Amp
60% Duty Cycle

THE MID-STATES *Magna-Tran*

AC/DC INERT GAS ARC WELDER

New PLUG-IN timer control: pre-flow — post flow — high frequency drop out and SPOT-ARC. Convert to inert gas welding in the field by plugging in proper timer. SILICON FULL WAVE RECTIFIERS provide superior welding performance on D C application. Patented saturable shunt transformer permits remote and panel control of amperage by rheostat dial. No moving parts reduces maintenance. Indicating light to show operating functions. Panel mounted high frequency assembly for ease of adjustment and maintenance.

THE MID-STATES *Viking* AC/DC

SINGLE PHASE ARC WELDER

Patented movable shunt dual coil transformer provides stepless current adjustment. SILICON Rectifier may be factory installed or field installation may be made at a later date. Full 75 volt open circuit starts arc instantly with all types of electrodes. Sturdy all weather baked enamel case. Smooth stable arc over entire range. Skid mounted — three wheel truck available.

200-300-400 Amp
60% Duty Cycle

Dealer Inquiries Invited

MS

MID-STATES WELDER MFG. CO.

6025 South Ashland Ave. Chicago 36, Ill.

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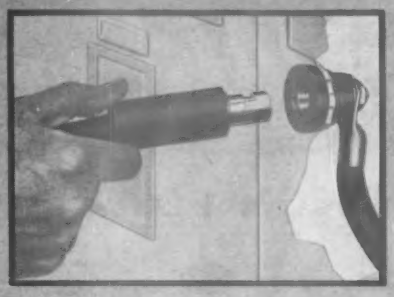
Specify



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POWER CONNECTIONS

"The Standard of the Welding Industry"

CAM-LOK is standard equipment on various welding machines manufactured by . . .

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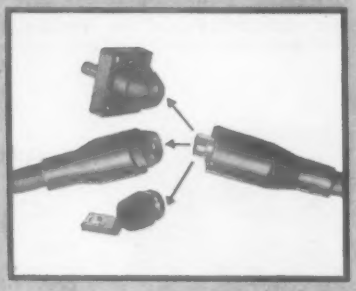
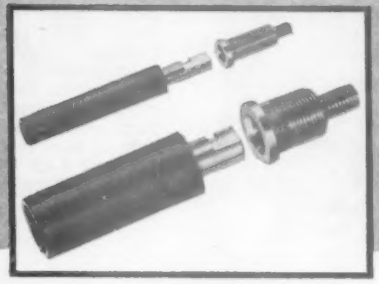




Modern power distribution in the welding industry demands a fast, high pressure positive connection with minimum resistance that is rugged, simple and economical. And leading welding machine manufacturers build Cam-Lok connections into their equipment for safe, full power distribution.

Make a better connection now with Cam-Lok, and speed up your production. Write for complete line catalog on plugs, connectors, and receptacles or detail your special requirements.

cam-lok DIVISION

EMPIRE PRODUCTS INC.,
9213 E. BLUE ASH RD., CINCINNATI 42, OHIO

METAL-to-metal surfacing process brazes base joint of office desk tubular leg.

Powdered metals sprayed, fused by oxyacetylene flame

POWDERED METALS can now be sprayed and fused simultaneously on a base metal with an oxyacetylene flame.

The new technique, called Aircospray and developed by Air Reduction Sales Co., New York City, is designed specifically for hardfacing and brazing.

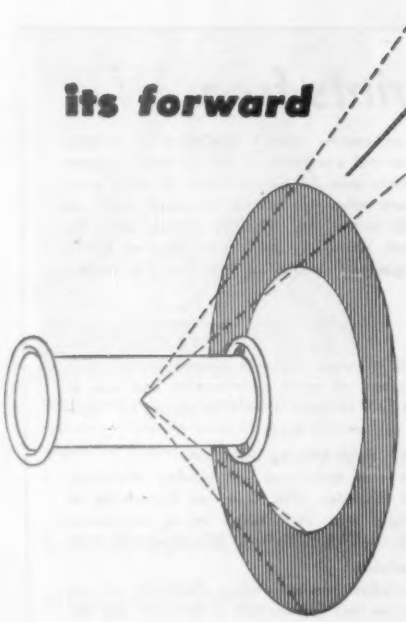
Especially useful in depositing high-melting-point powdered metals, this technique can be used on pistons, valves, saw blade guides and sliding surfaces on engines, pumps and farm machinery.

Used with phosphorus or silver filler metals, the technique provides capillary brazing and permits placement of filler metal, combined with flux, directly on the joint area. This makes the process useful in fabricating office furniture and sanitary joints for hospital furniture.

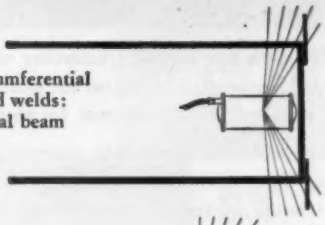
In addition, it can be used for metal spraying solely and spraying subsequent to fusing.

Employing a standard oxyacetylene welding outfit with a modified torch tip permitting powdered metals to be sprayed through the flame, depositions down to 0.003-in. thick can be made. The carrier gas source dispenses and carries powdered metal to the torch tip and necessary controls. Carrier gas may be argon, helium, nitrogen or CO_2; fuel gas can be acetylene or natural gas.

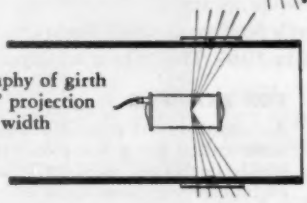
its *forward throw* 360° radial x-ray beam makes light work of tough radiographic jobs like these



Inside-out one shot circumferential radiography of tank-head welds: the forward-thrown radial beam gets the whole corner.



Circumferential radiography of girth welds: the wide-band 30° projection x-rays the full seam with width to spare on either side.



Easy setup for simultaneous panoramic radiography.

Despite the power it packs, the tubehead is light enough for one man to handle.

find all this in the

NEW

ANDREX FT360

160 KV portable x-ray unit

Easy to position anywhere . . . here it is being lowered for "one-shot" radiography of a massive girth weld.

lightweight
one man can easily carry its 72 lb. tubehead

compact
can enter a 9" diameter opening

powerful
full 160 KV takes 2" steel, 5" aluminum in stride

selfcontained
complete weatherproof "package"—no shockproof cables or water lines

economical
an investment that will pay manifold dividends for years for a modest outlay of

Call any Picker branch office (see local 'phone book) or write Picker X-Ray Corporation, 25 South Broadway, White Plains, N. Y.

Picker x-ray

one stop for everything in industrial radiography

ANDREX — portable x-ray units—130 KV, 160 KV, 200 KV, 260 KV

PICKER — x-ray units—5 to 50 KV, 150 KV (stationary and mobile), 270 KV portable, 260 KV heavy-duty

TECH/OPS — units for isotope radiography—sources, equipment, containers for Iridium ^{192} Cobalt ^{60} and Thulium ^{170}

ACCESSORIES — . . . films, tanks, darkroom sundries, illuminators, *everything*

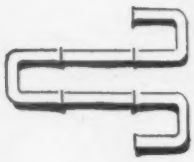
For more facts Circle No. 179 on Reader Service Card

GOT A JOINING PROBLEM?

Having trouble with corrosion? Dissimilar or unusual metals? Successive joints on the same work? We'll tackle it . . . at no cost to you.

Tough joining problems gave this company its start. Every time we solved a problem we had a new customer . . . and often a new product to sell! That's how we got into the special alloys business in 1946. That's how we grew.

FOR EXAMPLE



Automobile air conditioning units called for a low-cost but highly corrosion resistant heat exchanger with freon-tight seals in aluminum tubing. ALL-STATE developed a cadmium-zinc alloy that was low in cost, resistant to all atmospheric conditions, and leak-proof. Same alloy now used for repair of automobile radiators.

Our 430° non-acid flux was developed for joining stainless with minimum hazard to users. A subsequently discovered application was joining Hydro T-metal without discoloration.

It took months to figure out how to braze the cathode wire to the terminal inside radio vacuum tubes without blackening the inside of the tube. Our silver-copper-indium alloy lowered brazing temperature without increasing vaporization rate, solved the problem.

Stainless steel kitchen sinks became economically feasible only after we helped a manufacturer solve the problem of a perfect color match with a monel gas welding rod.

We still like tough joining problems. That's why we invite you to put your joining problem up to us. We may fail or succeed, but we'll work on it with the best research brains and equipment, and it won't cost you a penny.

Write and tell us what your joining problem is, with the essential details.

Send for a free copy of our 56-page Manual and Catalog.

Distributors everywhere

All-State ALL-STATE WELDING ALLOYS CO., INC.
White Plains, N.Y. Dial 914 WH 8-4646
QUALITY WITH SERVICE

Reprints from WE

Reprints of certain articles published in Welding Engineer are still available. A list of these appears below. Reprints may be obtained for 15 cents each, except where otherwise noted. Payment must accompany all orders. For quantity orders, write for special prices. Order by title from: Reprint Editor, Welding Engineer Publications, Inc., Box 28, Morton Grove, Ill.

Fundamentals of wear resistant overlay
Explains causes of metal deterioration and how to avoid it and how to select a welding process for hardfacing. This reprint 25¢ each.

Techniques for torch brazing aluminum
Procedures and techniques for brazing aluminum, are detailed. Includes data sheet on brazability of aluminun alloys plus four tables listing commercial products and their characteristics. This reprint is free.

Design for welding
Basic knowledge required when designing, or redesigning for welded construction is detailed and discussed. Sixteen page reprint includes 11 data sheets.

The meaning of weldability
Weldability of carbon steels and alloy steels, as well as some other metals, is discussed. Sixteen page reprint includes three data sheets.

Tungsten inert gas
A 16 page report on the history, theory and application of the Tig welding process. Includes data sheet on proper current selection. This reprint is free.

Welding of dissimilar metals
Complete details on welding dissimilar metals using NiCrFe electrodes and wires. Eight page reprint includes charts on properties, test results and data sheet on properties of other metals.

Acetylene
A 12 page salute to the IAA and acetylene, details the great success of this gas. Includes a history of the IAA and "The Acetylene Journal."

Fixtures for brazing
Presents requirements for designing brazing fixtures and materials to be used. Data sheet on properties of non-metallic fixture materials included. Free.

Filler metals for joining
Brazing filler metals are detailed and each group is analyzed. Includes data sheet on how to select silver brazing alloys.

Production welding controls
Discusses how material, labor and overhead effect total production welding costs, and how certain controls can result in greater time and dollar savings. This reprint is free.

New aluminum alloy not prone to brittle fracture
Extensive testing of 5083 aluminum alloy proves it has excellent weldability and weld ductility, and a good resistance to corrosion and stress corrosion. Testing for brittleness is detailed. This reprint free.

Explosive welding and forming open another door
A report on one of the newest entries into the welding industry, and how one pioneer company turned theories and practices into realities.

Our modern-day mythology
A rebuttal to some old-wives tales about the hazards of welding fumes, plus safety recommendations for situations where hazards might develop.

Understanding weld distortion and shrinkage
Causes of distortion and shrinkage can be determined if weld heat is understood. Eleven drawings are used to illustrate this welding problem.

LEAD-lined pool is swabbed with asphaltum to protect the lead from free lime in cement or mortar until curing is complete.

Lead-lined pools are welded

EIGHT WELDED LEAD-LINED pools are a major design feature of the Time & Life Building in New York's Rockefeller Center.

Since lead is pliable, will not corrode and can shrink or expand without springing a leak, it was chosen to line the pools which are located above business establishments and underground passages.

Using an electric power shear, the subcontractor, John F. Abernethy Co., Brooklyn, trimmed pool-size sheets from ⅛-in.-thick lead sheet weighing 1,500 lb to each 32-ft by 6-ft roll.

Tar paper covered with a thick coat of hot tar was then placed over each cement pool base. The lead sheet, with an asphaltum coating to protect it during the curing stage of the cement, was unrolled over the tar paper.

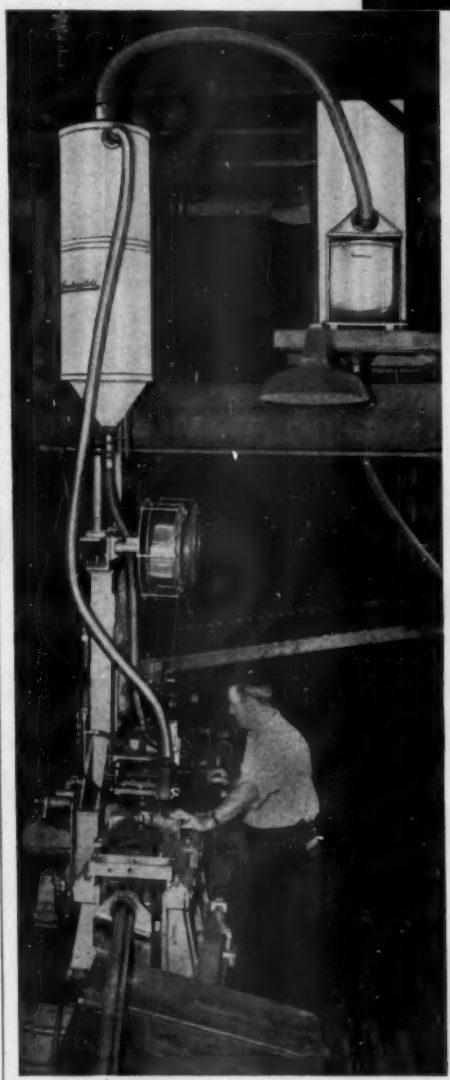
After a workman flattened the sheet edges with a leather-covered dresser, two lead weldors sweated the edges together with a finger tube — a flaming jet of mixed hydrogen and oxygen.

The weldors then used the tube two more times at 580 F to melt more lead into the joints until they were level with the sheeting surface.

When the welding was completed, the 5,000 sq ft of lead lining for the eight pools was buried under a ½-in. cement layer topped by three inches of terrazzo.

Savings in reclaimed flux alone have paid for Invincible units in a few months, or even weeks, on submerged arc welding jobs.

INVINCIBLE
Welding Flux Recovery Systems
MAKE 3-WAY SAVINGS



Operating continuously, this Invincible recovers all unfused flux from pipe-seam welding operation at a leading automotive firm.

1 *Valuable Flux Reclaimed. Automatic* Invincibles recover *all* unfused flux and return slag-free, dust-free usable flux to the welder — *all in one continuous operation.*

2 *Costly Man-Hours Saved.* Invincibles do the complete job automatically — far more swiftly and efficiently than manual methods.

3 *Fewer Expensive Rejects.* Invincibles remove all fine dust (flux flour), thus reducing welding rejects and speeding production.

Many Important Advantages

- Ruggedly built to resist abrasive nature of flux.
- Compact and lightweight. Variety of models and flexibility eliminate need for tailor-made installations.
- Portable units also available.

WRITE TODAY FOR FOLDER on Invincible Flux Recovery Systems.

INVINCIBLE VACUUM CLEANER MFG. CO.
DOVER, OHIO

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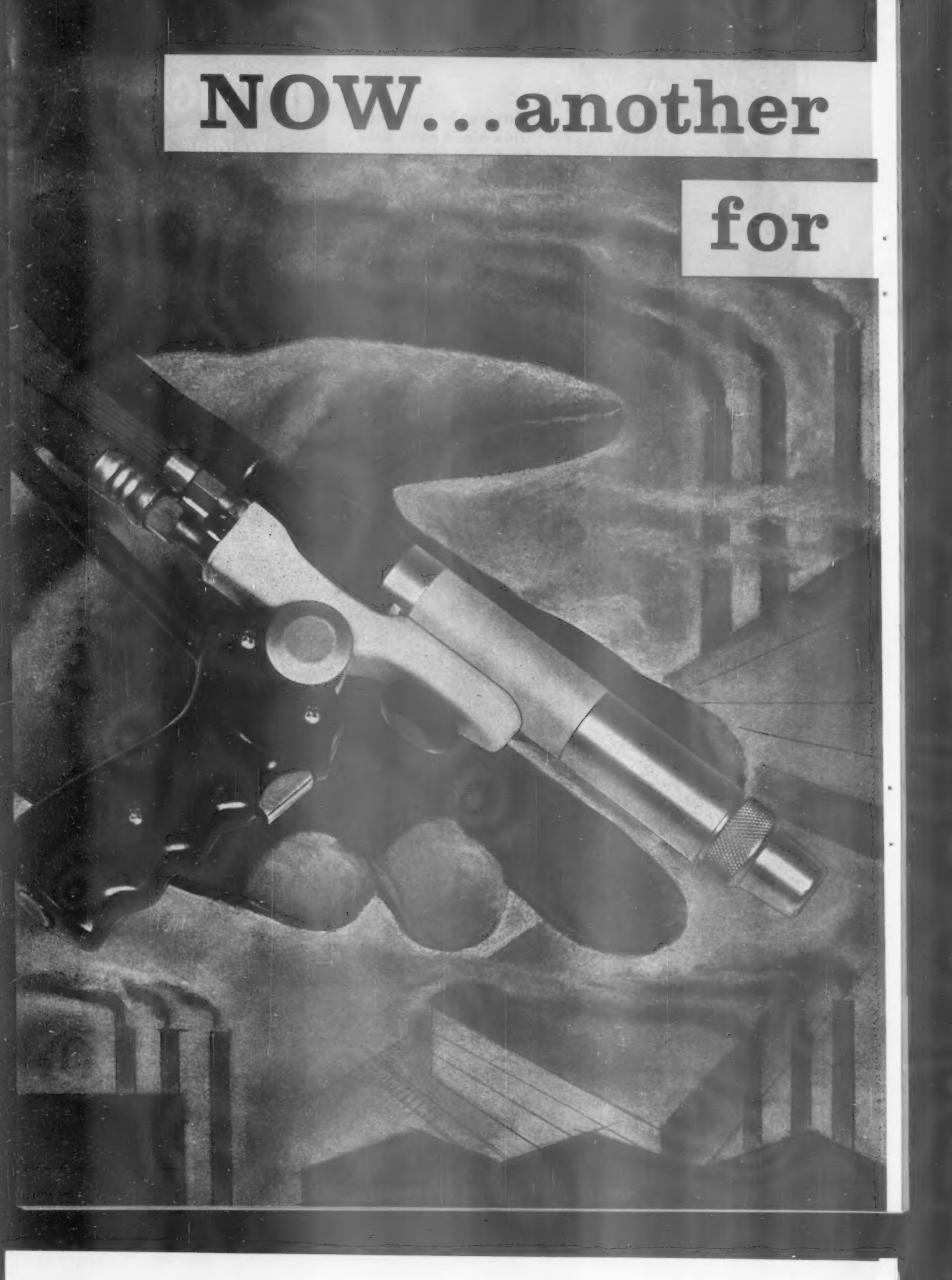
NOW...another

for



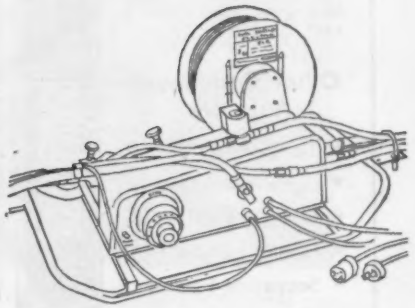
step forward

production welding

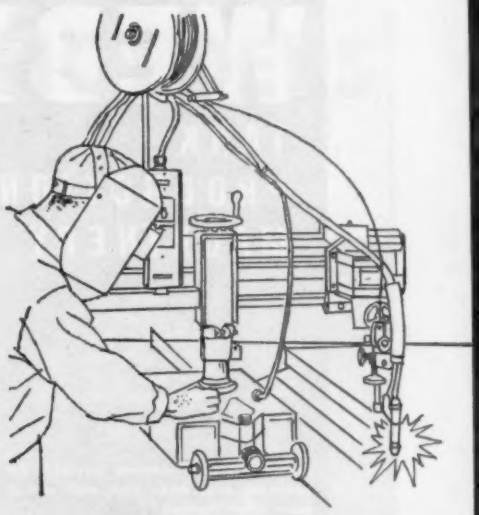
Progress means greater profits for you. The NCG AM-7 Gun for Automanual* welding is the newest, most improved consumable welding gun on the market. Its outstanding versatility, its low maintenance, its adjustable handle for welding ease and accessibility all mean increased production. And, it provides complete gas shielding using 25% less gas.

The multi-use barrel of the AM-7 Gun, designed for all MIG and carbon dioxide shielded welding processes, is interchangeable with the NCG A-10 Automatic Torch and may be used for all MIG, carbon dioxide shielded and TIG welding processes. And, for even greater versatility, a simple change of the guide tube accommodates ferrous or non-ferrous metals.

Send for complete information today. Ask for the new NCG Bulletin NH-142-E-**2-B,** NATIONAL CYLINDER GAS DIVISION OF CHEMETRON CORPORATION, 840 North Michigan Ave., Chicago 11, Illinois. NCG sales offices, distributors and dealers in all principal cities.



The new WC series welding control units have features that were developed to meet field requirements. Designed for consumable electrode welding processes using argon, helium or carbon dioxide shielding gases, they provide maximum versatility and economy.



Multi-purpose barrel is interchangeable with the NCG A-10 Automatic Torch for MIG and TIG welding.

NCG®

NATIONAL CYLINDER GAS

Division of CHEMETRON *Corporation*

*NCG trademark for semi-automatic welding process and equipment

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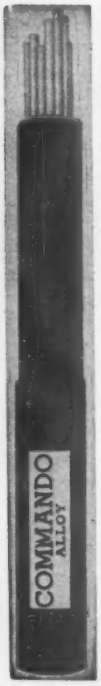
COMMANDO

ROD

No Flux Required

Ideal for Brazing Aluminum and Welding Zinc Base Diecastings. COMMANDO ROD is easy to use with all types of welding equipment. May be applied with regular torch; acetylene and air torches; hydrogen, natural gas or bottled petroleum gases. Flows freely at 715°.



Other Commando Products

- ★ Tip Cleaning Drills
- ★ Lighters and flints
- ★ Goggles head bands
- ★ Ferrule crimper
- ★ Soapstone holders

J. M. COMMANDO INDUSTRIES

2715 Oak Street Kansas City 8, Mo.

News....from page 8

$25,000 to be awarded in welded design program

The James F. Lincoln Arc Welding Foundation, Cleveland, has announced a $25,000 award program for progress in arc welded design.

The program offers cash awards for papers describing the welded steel design of either machines or structures. Awards are being made to advance progress in the development of better machines and structures through more efficient use of arc welded steel and to recognize individual contributions to this progress, according to Dr. E. E. Dreese, chairman of the foundation.

Competition is open to any U. S. resident who has taken part in the design, planning, or production of the design described in his paper. Separate awards will be made for machines and structures; a total of $12,500 will be awarded to the 38 papers judged best in each group.

In the machine design competition, papers must present a discussion of the use of arc welded steel in the design of either a complete machine or a machine component, including achieved or expected results relating to performance, and/or appearances, savings in material, time or money, made possible through welded design. Competition for the awards closes July 17, 1961.

Glove distributors open membership drive

The National Association of Industrial Glove Distributors has launched a campaign to expand membership.

A nationwide mailing of invitations to prospective members is being undertaken to aid in expansion plans. Requests for applications should be sent to Penn Affiliates, Inc., Executive Director, 11 W. 42nd St., New York 36, N. Y.

A. O. Smith holds Texas welding show

A three-day welding show held recently in Houston, Tex., by A. O. Smith Corp., Milwaukee, drew about 300 industrialists, farmers, fabricators and contractors.

Held under a "big top" circus tent on the A. O. Smith Corp. of Texas pipe mill grounds, the show featured working demonstrations of techniques ranging from utility farm welding to CO_2 projection welding.

WEBB

TANK PRODUCTION MACHINERY

Horn Jigs
Offsetters
Seam Welders
Turning Rolls
Track Supports
Assembly Presses

Model M-2 with rotating turntable for reversing ends when both ends are to have offset flanges.

Complete catalog on any type or size machine furnished on request.

Since 1881

THE WEBB CORP.

REED EQUIPMENT DIVISION

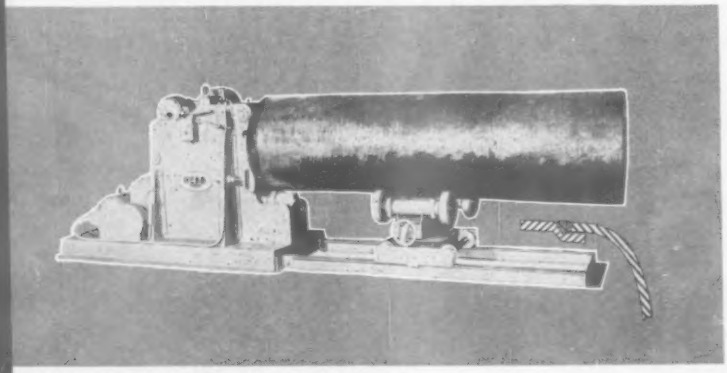
WEBB CITY, MO., U.S.A.

WEBB OFFSETTER

for forming an offset flange around shell ends to facilitate automatic welding of tank heads.

- Eliminates chill rings
- Improves concentricity of shell ends
- Shortens fit-up time
- Helps reduce welding time

Available in four models to handle up to ½" plate.
With standard dies.
New M 2-P pipe duty 6" to 30" up to ¼" thick.



WEBB ASSEMBLY PRESS

Companion fixture for assembling heads to shells — shells to shells.
• 25 tons closing pressure • Built-in fit-up rolls • Built-in kick-out lift • Adjustable for tank diameter and length
3 standard sizes to handle up to 72" diameter
Combination Assembly and Girth Welding Machines also available.

IN SUMMARY...

S.M.S. Corp., Detroit, has been merged into **P. R. Mallory & So., Inc.**, and will be known as the Birmingham plant of **Mallory Metallurgical Co.**, a division of P. R. Mallory & Co., Inc. . . . **Chemetron Corp.**, Chicago, has acquired, for cash, **Northwest Chemical Co.**, Detroit, manufacturer of chemicals used in metalworking . . .

Santa acquired a small army of helpers in 1960 when **Eutectic Welding Alloys Corp.**, Flushing, N. Y., joined the U. S. Marine Corp's annual "Toys for Tots" program. Eutectic President Rene D. Wasserman (see cut) welded the first toy. . .

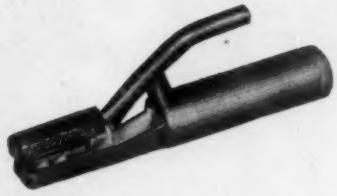
A high-temperature insulation for combustion chamber linings for oil and gas fired furnaces, for components for processing molten aluminum and for industrial heat treating and brazing furnaces has become a standard product for **The Carborundum Co.**, Niagara Falls, N. Y. . . . **International Ultrasonics, Inc.**, has moved its offices and production facilities from Rahway, N. J. to 531 Centennial Ave., Cranford, N. J. . . .

DURO ELECTRODE HOLDERS

THE DURO "STANDARD"

* Featuring "Long Jaw Design" for reaching hard to get at places.
* Cool operation-cool handling.
* Insulated handle and guard protects the operator.
* All parts easily replaced.

THE "ADJUSTABLE TENSION"



* Easy adjusting of Spring Tension for your requirements.
* New type cable connection prevents fraying of cable.
* Aluminum model weighs only 13 oz.
* All parts replaceable including copper alloy jaw.

For further information write:

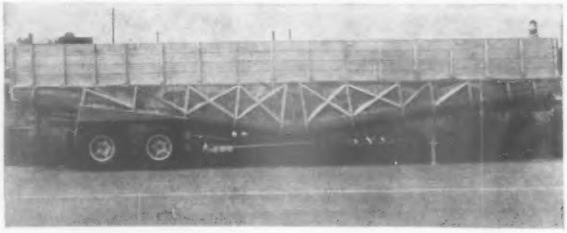
THE DURO ENGINEERING COMPANY

71 Oregon Avenue, Hamden 17, Connecticut

Metal & Thermit Corp., New York City, has formed a wholly owned subsidiary in Zug, Switzerland, to increase participation in the European market . . . The **American Society for Metals' Foundation for Education and Research** will present $30,500 in college scholarships to metallurgical students this year . . .

Square D Co., Park Ridge, Ill., has purchased a 98,000-sq-ft plant from Gorham Mfg. Co., Asheville, N. C. The plant will serve as headquarters for Square D's commercial control division . . . **Superior Propane Ltd.**, Toronto, has acquired the assets of the **Gaz Propane Ste. Marie Co.** of Ste. Marie de Beauce, Quebec . . .

A new all-aluminum Mig welded two-way trailer for both liquid and dry cargo payloads (see cut) has been introduced by **Standard Steel Works, Inc.**, North Kansas, Mo. The trailer weighs 10,715 lb and can carry up to 42,600 lb. . .



Air Reduction Pacific Co., San Francisco, has moved its sales, service and warehouse facilities in Portland, Ore., into larger quarters at 1325 N.W. Kearney St. . . . **The Crucible Steel Co.**, Pittsburgh, through its wholly owned subsidiary, **World Crucible Ltd.**, has established an Australian company, **Crucible Steel Australian Pty. Ltd.** . . .

A new **National Cylinder Gas Div.** transfilling station at 529 Felicity St., New Orleans, will serve southern Louisiana with oxygen . . . A 30-session farm welding clinic designed by **A. O. Smith Corp.**, Milwaukee, to bring farmers up-to-date in the theory and practice of welding farm machinery, is currently underway in five Midwestern states . . .

ANOTHER Dockson FIRST
NEW CHIPORWELD EYESHIELD
• BROADER VISION • BETTER VENTILATION • LOWER COST
Chiporweld Eyeshields offer broader vision, maximum service, comfort and economy in a completely new design . . . for use with or without prescription glasses. A real quality product at a bargain price.
Dockson CORPORATION
3839 WABASH
DETROIT 8, MICH.
Interchangeable chip or weld lenses.
Anti-fogging lens separator.
Comfortable face cushions.
Comfortable, adjustable headband.
Huge, baffled ventilation ports.
Broad, comfortable nose cradle.
Molded, one-piece pliable plastic frame.

VIPs in review

Kenneth R. MacLean has been elected vice president of sales and *Louis F. Palana* has been elected vice president of operations for The Crescent Co., Inc., Pawtucket, R. I. Crescent has also named *David J. Murphy* controller and *William E. Ethier* general foreman.

Kenneth C. Tate, formerly with Aerojet General Corp., Azusa, Cal., has joined Jackson Products, Warren, Mich., as Pacific Northwest regional representative with headquarters in Portland, Ore.

Tate

Williams

Hand

Johnson

J. J. Williams is the new assistant vice president in charge of sales for Alloy Rods Co., York, Pa. Williams was formerly eastern regional manager for the firm. Alloy Rods has also named *C. C. Hand* and *M. L. Johnson* district managers. Hand will be headquartered in Pittsburgh. Johnson will be headquartered in El Segundo, Cal., and will cover the western states.

Eutectic Welding Alloys Corp., Flushing, N. Y., has appointed *Richard L. Carpenter* manager of the Dallas Service & Training Center. He was formerly manager of credit and dealer sales for Clearview Corp., Dallas.

Mobilweld, Inc., Chicago, has elected *Max K. Ruppert* chairman of the board and *Earle F. Cox* president. The newly formed company (see January *Weld Word* p. 19) also elected *C. Richard Sherer,* vice president; *A. J. Frystak,* secretary; and *R. E. Mitchell,* treasurer.

A LEADER
for over 40 years . . . SHAWINIGAN

Warehouse stocks in all important cities and towns.

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EMPIRE STATE BLDG., NEW YORK 1, NEW YORK
PLANTS: Keokuk, Iowa; Pryor, Oklahoma; and Shawinigan Falls, Quebec, Canada

CMD®
THE chipping hammer WITH SWING BALANCE

This is the hammer with the balanced feel—swings easy, fits the hand properly, absorbs shock. *Less fatigue* and it's a pleasure to use!

CMD heads are made of ¾" square tool steel. They can be re-sharpened right down to the shaft!

Type A 20 oz., drift and right angle chisel.
Type C 14 oz., drift and chisel.

CHICAGO MANUFACTURING & DISTRIBUTING CO.
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TYPE A TYPE C

Arthur W. Thornton has been appointed director of engineering and research for National Tube Div. of U. S. Steel Corp., Pittsburgh. He had been general superintendent of the division's Lorain, Ohio, works. Also at U. S. Steel *Norman C. Michels* has been appointed vice president of facility planning and appropriations.

Charles E. Wolfe has been transferred to Dallas to represent Inland Steel Co. in northern Texas and northern Louisiana. *Stuart A. Pennels* has been transferred from Chicago headquarters to replace Wolfe in the Houston office as sales assistant.

Jack Weir, formerly with North American Aviation, Inc., Los Angeles, has joined The Fibre-Metal Products Co., Chester, Pa. Weir will work with welding and safety distributors in Southern California, Arizona and Southern Nevada.

Richard H. Snyder is the new Middle Atlantic regional manager for J. B. Nottingham & Co., Inc., New York City. Snyder will be in charge of sales and service for welding and lighting power and distribution equipment.

Harry C. Robeson has been named vice president and assistant general manager of Detroit Stamping Co., Detroit. Robeson has been vice president of sales since 1958.

Thermal Dynamics Corp., Lebanon, N. H., has appointed *Lawrence W. Scammon* product manager for special equipment and processes while *George A. Klasson* has been named sales manager of plasma cutting devices.

The Lincoln Electric Co., Cleveland, has named *C. O. Planting* district manager of the Detroit sales territory. He succeeds *A. F. Boucher* who was recently appointed assistant general sales manager.

W. E. Gregg, formerly vice president of technology for Crucible Steel Co. of America, Pittsburgh, has been appointed vice president of operations succeeding *J. D. Dickerson*. Crucible has also appointed *E. A. March* director of technology.

Premier Industrial Corp., Cleveland, has appointed *John J. Windahl* sales equipment manager. Windahl was formerly promotion manager for Mills Co., Cleveland.

Air Reduction Sales Co., New York City, has appointed *J. H. Berryman* manager of the special products department in Union, N. J. The department manufactures and sells welding, cryogenic and gas handling equipment. Airco has also appointed *L. W. Kunkler* district manager of the Buffalo office. *Joseph P. Casalis, Jr.*, has been named St. Louis district manager for Airco replacing *W. M. Holley* who resigned to become a distributor.

Kunkler

Siebert

Carl J. Siebert, Jr., has been named general sales manager for Aronson Machine Co., Inc., Arcade, N. Y.

J. J. Laputka has been named financial vice president of Air Products, Inc., Allentown, Pa. He was formerly financial vice president of Gorham Mfg. Co., Providence, R. I.

Robvon's Commercial Backing Rings are designed for quick easy alignment of pipe or tubing and assure precise close tolerance fit-up. Robvon Backing Rings allow complete penetration and fusion of the weld. Robvon Backing Rings radiograph perfect certified welds. The patented nubs automatically set the welding gap for the root-pass. The internal bevel and flat inner land assures non-restricted fluid flow.
ROBVON BACKING RINGS APPROVED FOR WELDING PIPE, VALVES AND FITTING JOINTS
ROBVON BACKING RING COMPANY
675 Garden Street
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ROBVON also manufactures machined rings to specification. Write for full information.
REG. PAT. NOS. 2,764,426 & 2,366,579

NEED GAS FAST?

Phone your Airco Distributor...

For oxygen, nitrogen, hydrogen, standard nitrogen-hydrogen mixtures (where available), argon, helium and standard argon-helium mixtures

Are you making or repairing construction or farm equipment, automotive bodies, office equipment, air conditioners, building panels, freezers, trailers or any of a hundred other fabricated products with oxyacetylene welding, Heliwelding or Aircomatic® welding? Or are you involved in scrapping or other cutting operations? Your authorized Airco Distributor is your local supply source for the super-pure gases that you need. And when you want that gas *fast*—your Airco Distributor can't be beat for prompt service.

Choose from the AIRCO quality line of high purity and rare industrial gases. Also gas welding and cutting equipment—gas-shielded arc welding process equipment—arc welding equipment and arc welders—flame cutting machines—electrodes—supplies and accessories.

You can get what you want from your nearby Airco Distributor. Phone today. He's listed in your Classified Telephone Directory under "Welding Equipment and Supplies."

AIR REDUCTION

. . . represented by over 700 Authorized Airco Distributors from Coast to Coast

AIRCO DISTRIBUTOR

Circle No. 190 on Reader Service Card

James F. Lincoln, chairman of the board of The Lincoln Electric Co., Cleveland, has been elected a senior board member of the National Industrial Conference Board for a 3-year term.

In changes at Epsco, Inc., Cambridge, Mass., *Ares G. Bogosian* has joined the advanced concepts engineering organization as manager. *F. Gorham Brigham, Jr.*, has been elected director, financial vice-president and treasurer of Epsco while *James P. LaBarber* has been appointed western regional manager for the instruments division and *Stanley A. Randler* has joined Epsco as director of marketing services. Radler, who was affiliated with American Electronics, will be responsible for special marketing programs for the five Cambridge divisions and Monitor Systems, Inc., Fort Washington, Pa., a subsidiary. Epsco has also added *Arden H. Frederick* to the instruments division.

B. H. Bradley has succeeded *B. J. Trautman* as manager of works of Pullman-Standard's Hammond Ind., plant. Trautman retired after 46 years with the firm.

Harry Schwartzbart and *Ray J. Van Thyne* have been named assistant directors of metals research at Armour Research Foundation, Illinois Institute of Technology, Chicago.

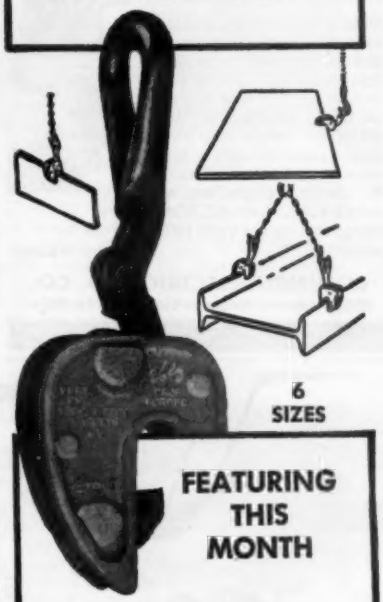
United Engineering Trustees, Inc., New York City, an organization of five major national engineering societies, has elected *Willis F. Thompson* president. He succeeds *Andrew Fletcher* in the office.

L. W. Bieker, Frank Albert and *Walter Chalberg* have been named respectively as project engineer, manufacturing engineer and plant manager for the $1½-million-dollar pipe plant being constructed in Lockeford, Cal., by Graver Tank & Mfg. Co., East Chicago, Ind. Graver has also named *Alan Law* chief industrial engineer for the firm and *R. W. Briska* has been appointed plant engineer. *E. G. Vail* has been promoted to take over Law's previous position as plant manager at Houston, Tex.

Harold H. Burrows, senior vice president of rubber sales, has retired after 45 years with Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J.

YOUR BEST MOVE . . . MOVE with **MERRILL** MATERIAL HANDLING DEVICES FOR THE MOST IN *Safety and Economy*

Imitated, but never duplicated, Merrill Lifting Clamps are Drop Forged to give you Safety in Handling and Economy in Operation.



6 SIZES

FEATURING THIS MONTH

TWIN-LIFTER
for lifting barrels, drums, with or without heads removed.

Over 25 Material Handling Devices described in our catalog C-2.

Ask for a copy.

MERRILL BROTHERS
Producers of Drop & Press Forgings
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Circle No. 191 on Reader Service Card

Circle No. 192 on Reader Service Card

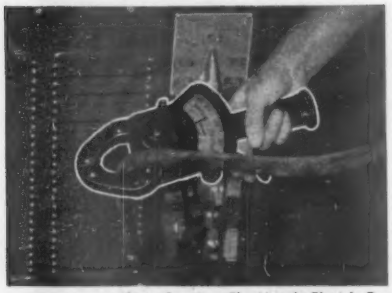


Photo Courtesy The Lincoln Electric Co.

NOW . . .

ONE AMMETER
for AC/DC WELDERS

Only TONG-TEST
measures both AC and DC

Weld with confidence. Use the exact amperage — no more, no less—to assure welding quality. Prevent costly rejects by controlling the welding current (AC or DC) with one TONG TEST AMMETER. Simply snap tongs around electrode cable — read amps instantly and accurately. No electrical connections required, cannot burn out. Interchangeable ranges up to 1000 amperes.

Write for Catalog WB-400

COLUMBIA ELECTRIC MFG. CO.
4531 Hamilton Avenue • Cleveland 14, Ohio

Cecil Milne has joined Fabriform Metal Brazing, Los Angeles, as a member of the sales staff. Milne has served as sales engineer for other area brazing companies.

Milne

Fisher

RWMA has elected *Simon Fisher* as president for 1961. Vice president for the year will be *Harry V. Beronius*, sales manager of Swift Ohio Corp., Kenton, Ohio. Fisher is president of National Electric Welding Machines Co., Bay City, Mich.

W. L. "Len" Farmer, regional manager of the Rego Div. of Bastian-Blessing Co., Chicago, has been given supervisory responsibility over the Kentucky territory. Under Farmer, *George A. Workman* will be district sales manager for Kentucky, Michigan, Indiana and western Ohio.

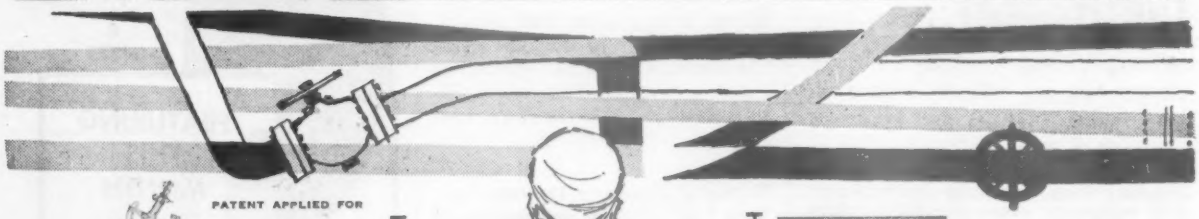
Gordon R. Loveless, manager of Chicago Bridge & Iron Co.'s Salt Lake City plant since 1957, has been appointed manager of the firm's plant at Greenville, Pa. Succeeding Loveless is *Alfred J. Larson*.

American Hard Rubber Co., a division of Amerace Corp., Butler, N. J., has appointed *John J. Bertram, Jr.*, manager of advertising and sales promotion.

Died . . .

Thomas J. Ryan, executive vice president of the Mechanical Contractors Association of America, Inc., New York City, died in the collision of two airplanes over New York City on Dec. 16, 1960. An expert on labor law and legislation, Mr. Ryan came to MCAA as executive secretary in 1959 from his position as assistant general counsel of the NLRB. He is survived by his widow, Thelma Marie, and three children.

Stuart C. Rockafellow, vice president and chief engineer of Robotron Corp., Detroit, died January 10.

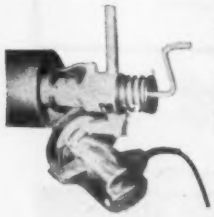


PATENT APPLIED FOR

STANDARD MACHINES

Fast, easy, accurate cutting and beveling of all sizes of pipe from 1½" through 36". Simple operation assures perfect cuts and bevels from moment torch is lighted.

PATENT NO. 2,960,293

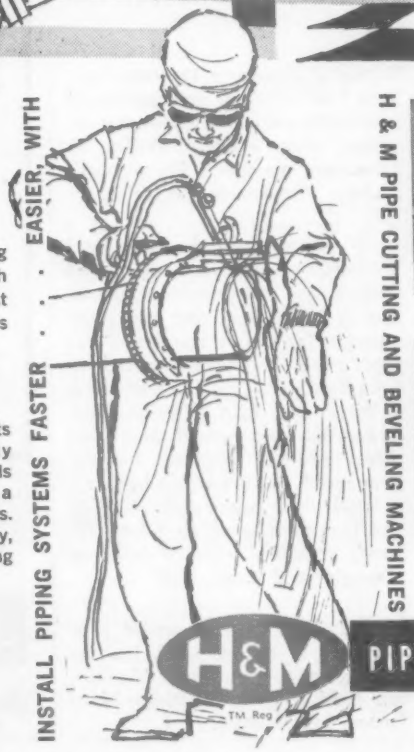


BEVEL-LAND GRINDER

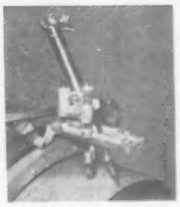
Smooths pipe cuts and accurately places the lands on bevels in a matter of seconds. Eliminates costly, time - consuming handwork.

H&M ACCESSORIES
Motorized Units
Flexible Shaft • Pipe Dollies
Boxes • Clamps

INSTALL PIPING SYSTEMS FASTER . . . EASIER, WITH



H & M PIPE CUTTING AND BEVELING MACHINES



PATENT NO. 2,843,373

OUT-OF-ROUND

Makes cutting of irregular pipe easy, simple. Roller rides surface of pipe, insures even, accurate cuts. Fits all sizes of H&M Machines.

PATENT APPLIED FOR

SHAPE CUTTER

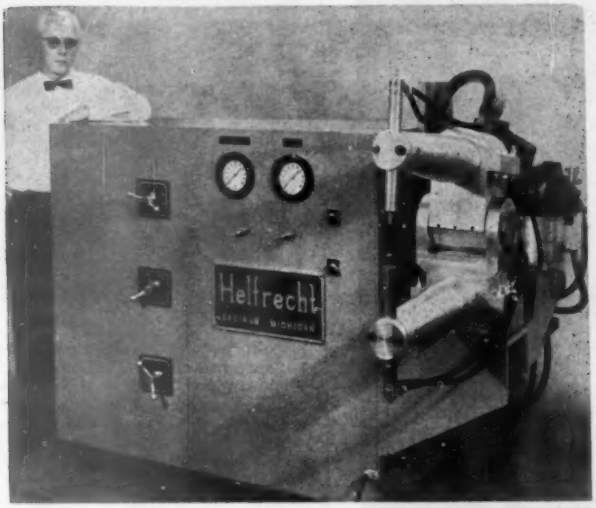
Cuts saddles, tees, els and other irregular designs. The lightweight extremely portable Shape Cutter fits all models of H&M Machines.

H&M TM Reg

PIPE BEVELING MACHINE CO.

311 E. Third St. LU 3-0241
TULSA, OKLAHOMA

New products . . . . . use card on page 85



Resistance welder

Unit has lower power demand than single phase welder through balanced 3-phase demand. Silicon type rectification permits higher peak inverse voltage rating than previous rectification. Voltage can be designed into equipment requiring more voltage. Unit overcomes self healing problem when peak inverse voltage is exceeded through firm's transient protection method. Controls using a standard 3B timer and dual ignitron contractors or various combinations are available. *Helfrecht Machine Co.*

Circle No. 1

Plasma spray gun

Portable 80-kw arc plasma hand spray gun deposits coating material over three times faster than other portable plasma spraying devices, according to manufacturer. Gun weighs 4½ lb and is 2⅝-in. diameter by 4-in. long. *Plasmadyne Corp.*

Circle No. 2

Cryogenic couplings

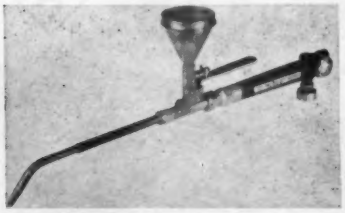
Lightweight cast-aluminum cryogenic coupling is designed for use with liquid oxygen, nitrogen. The couplings, built in accordance with Army and Air Force ballistic specifications, provide positive sealing by replaceable semi-soft liquid oxygen compatible plastic gasket mounted in aluminum seat. Male and female couplings supplied with dust caps and plugs. Couplings are rated at 150-psi operating pressure, 300-psi proof pressure, and 450-psi burst pressure. Coupling available in 1 to 4-in. size for oxygen and 1 to 3-in. size for nitrogen. *The Cosmodyne Corp.*

Circle No. 3

Metal-cutting electrode

Metal-cutting electrode operates on a-c as well as d-c. Applications include chamfering, beveling and grooving in preparation for welding. Operation is within same amp range for a-c or d-c. With a-c, electrode can be brought to work rather than bringing work to where d-c is available. Electrode can be used with any metal, particularly very hard and highly-alloyed metals for which torch cutting is not practical. Conventional electrode holders can be used with no oxygen nor compressed air required. *Eutectic Welding Alloys Corp.*

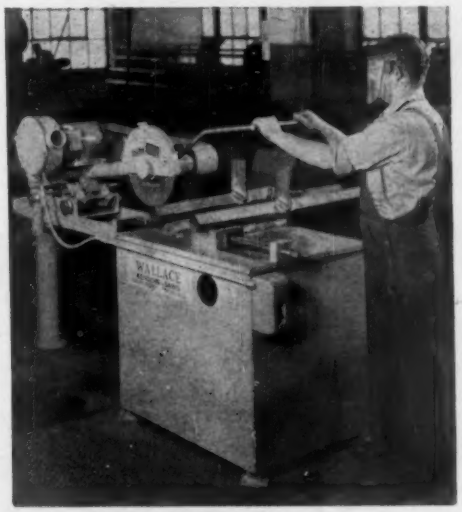
Circle No. 4



Brazing torch

Brazing torch for high-temperature brazing and overlay work uses alloy metal powders. Unit employs built-in aspirator to feed powdered metal into oxyacetylene flame. Powder is drawn from small hopper attached directly to torch body. For volume work, hose connection permits drawing powder continuously from separate large container. Alloys available for hardfacing and brazing. *Coast Metals, Inc.*

Circle No. 5



Cut-machining unit

Cut-machining unit can cut steel plate 3 in. by 24 in. or 72 sq in. in about 4 minutes. Unit can cut 20-in. I-beam weighing 65.4 lb per ft in less than one second per lb. Unit can produce surface finishes finer than 100 rsm. Machine will also cut aluminum, brass, copper, etc. and most plastics in less time with an equally good finish. *Wallace Supplies Mfg. Co.*

Circle No. 6

Mask goggles

Improved flexible mask goggles have snap buttons to hold lens securely in frame. Lens will not pop out but can be removed quickly and easily for cleaning or replacement. Goggles have recessed slots at cup sides to fit over temples when worn with glasses. Increased eyecup depth gives added ventilation and wider mask edge to mold to face contour. *American Optical Co.*

Circle No. 7

Attaching kit

Low-cost kit provides material to attach iron to ceramic tile, wood to plaster, steel to concrete, glass to aluminum, etc. Mixing is simple, fast and guess-proof. *Fybrglas Industries*

Circle No. 8

Welding, cutting outfit

Oxyacetylene outfit for light to medium welding and cutting features welding torch with three heads for welding up to ⅜ in. Cutting attachment has nozzle for cutting up to 2 in. Outfit also contains 12½ ft. of oxygen and acetylene hose, friction lighter, goggles and complete operating instructions. *Linde Co.*

Circle No. 9

Job report courtesy of Conch Methane Co., Ltd.

when pipe joints must be completely dependable at minus 258°F

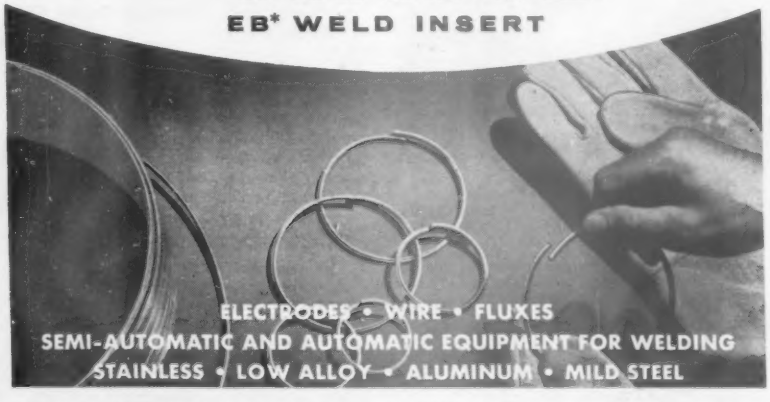
The engineers who successfully "broke through" the problem of handling liquefied methane gas on and off the "METHANE PIONEER" at minus 258°F had to "play it safe" in every respect. To provide unquestionably *safe* stainless pipe joints, Arcos EB Consumable Weld Inserts were used to make the important root passes.

EB Inserts permit welding to be done from one side only. They eliminate back-up ring obstruction and produce a smooth inside contour to expedite gas flow. If you are not familiar with the advantages of EB Weld Insert for "tough" pipe joining problems, write ARCOS.

*Trademark of General Dynamics Corp.

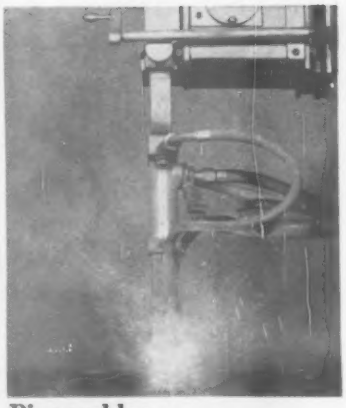
WELD WITH ARCOS

EB* WELD INSERT



ELECTRODES • WIRE • FLUXES
SEMI-AUTOMATIC AND AUTOMATIC EQUIPMENT FOR WELDING
STAINLESS • LOW ALLOY • ALUMINUM • MILD STEEL

ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.



Pipe welder

New process for fully automatic pipe welding, first reported in *WE* Oct. 1960, eliminates need for manual stringer bead or backing ring. Microwire automatic welding equipment includes wire feeder coupled to specially designed constant-voltage motor-generator welder. Filler wire is fed to fixed welding torch for flat or roll welding or to lightweight hand torch for semiautomatic applications. Process differs from conventional CO_2 Mig in that small-diameter wire electrode, usually 0.200 in. to 0.045 in., is used. Low arc voltage is in 16 to 20-volt range and low current is from 30 to 150 amp d-c reverse polarity. *Hobart Bros. Co.*

Circle No. 10

Portable oxygen unit

Portable oxygen unit useful in shock cases contains 360 liters of oxygen, enough for 40 minutes' use. Weighing 22 lb, unit can be easily operated without special training. *The Burdett Oxygen Co.*

Circle No. 11

Line regulators

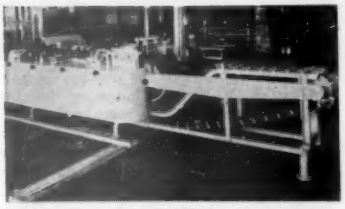
L-40-AR series line regulators are for all common gases. Units will provide sensitive control and will pass 0 to 100 cfh. All have 1/4-in. pipe thread inlets to prevent accidental mounting in high-pressure cylinders. Uniformity of gas control and prevention of back pressure entering pipe is assured. *The Harris Calorific Co.*

Circle No. 12

Testing machine

Machine can make tensile, compression and guided bend tests. Motor and hydraulic power unit are located in tester base and controls mounted in front. Model TE-10-AS has 10,000-lb capacity. Compact machine has 14-in. by 24-in. floor space and 74-in. height. Machine weighs about 500 lb. *Steel City Testing Machines Inc.*

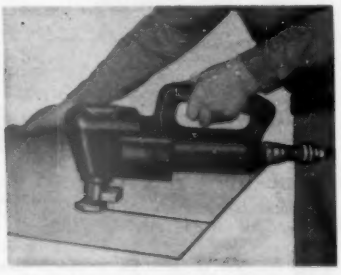
Circle No. 13



Welding-rod packer

Unit automatically packs, seals welding rods in corrugated carton and individually prints and glues identifying label across top of sealed container. Cartons are stacked in magazine; folded carton is then opened automatically and rods are packed by compressed air powered by available electric current. Unit can pack 12 containers per minute. Available for export to the United States, the machine can pack 14-in. or 18-in. length containers. *Machinefabriek P. van Houten*

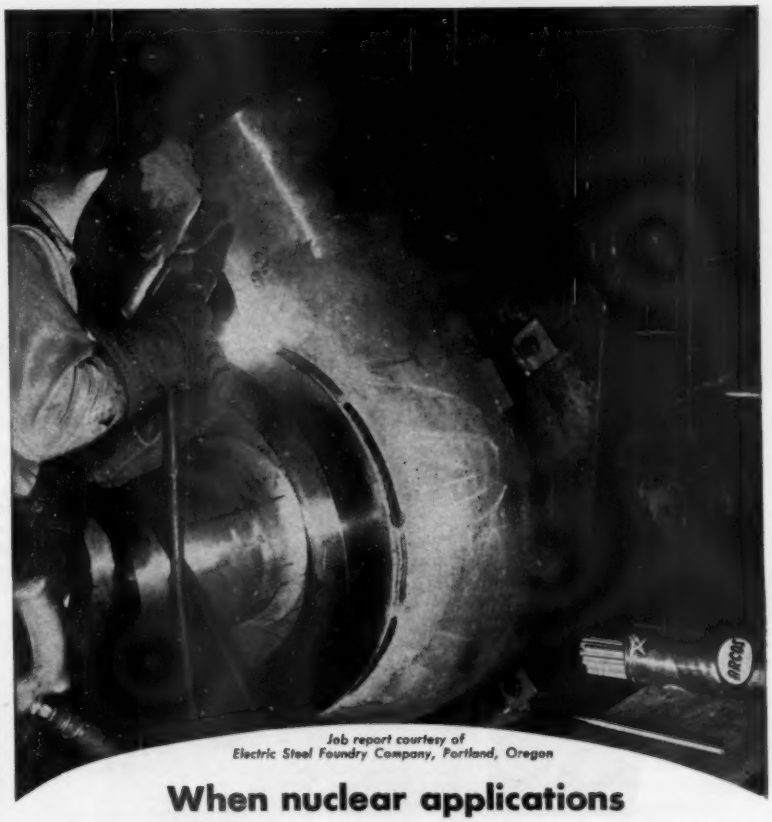
Circle No. 14



Air-powered nibbler

Portable air-powered nibbler is designed for cutting 1/4-in. steel plate, 8-gage stainless steel, and 5/16-in. aluminum. Cutting speed is 40 to 45 ipm. Model EAN also cuts any size radius from 8 in., weighs 18½ lb. *Fenway Machine Co., Inc.*

Circle No. 15



Job report courtesy of Electric Steel Foundry Company, Portland, Oregon

When nuclear applications call for stainless welds of highest quality

WELD WITH ARCOS

STAINLESS ELECTRODES

This is part of a 3900 lb. stainless pump-volute casting for a submarine nuclear power plant. In the photo, a skirt is being welded to the casting using 5/32" dia. Arcos Chromend K Electrodes. To minimize stresses, a step-back and skip procedure was used. These welds conformed to Class I Navy radiographic standards—an indication of the dependability of standard Arcos electrodes for your stainless welding needs. ARCOS CORPORATION, 1500 South 50th St., Philadelphia 43, Pa.

"Four Nines"
make $99.99 equal $134.94!

That's right—buy the whole package and you save $34.95! This is a complete "Purox" welding and cutting outfit that you can amortize in just a few jobs.

Sold separately, these components would list at a total price of $134.94—still a good buy, considering the top quality that "Purox" stands for. But with this "Four Nines" kit, you get a complete outfit for welding, cutting, heating, and brazing . . . all first-quality materials at a budget price. The "Four Nines" Outfit includes a welding torch with three heads, cutting attachment with one nozzle, oxygen and acetylene regulators, 12½ feet each of oxygen and acetylene hose with fittings, friction lighter, and goggles.

See it at your LINDE distributor's. Or, write for literature to Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada,* Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

LINDE COMPANY

UNION CARBIDE

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Air regulators

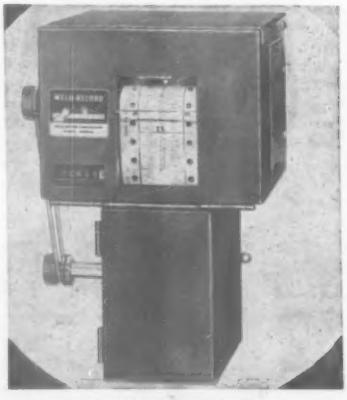
Air-pressure regulator can reach inaccessible air lines. In Pilot Controlled regulator, column of controlled pressure air replaces adjusting screw and control spring in standard regulators. Air column applies constant force on diaphragm and is governed by pilot regulator operating at practically no-flow to assure prompt response, highest air flow rate and accurate pressure control. *Hannifin Co.*

Circle No. 16

Lightweight eyeshield

Lightweight low-cost welding eyeshield has roomy one-piece pliable molded-plastic frame. Frame rests lower on face to provide broader field of vision. Edges have flange-cushions. Nose cradle is cupped for broad bearing. Eyeshield may be used with or without prescription glasses. Plastic spacer frame between lenses prevents fogging. *Dockson Corp.*

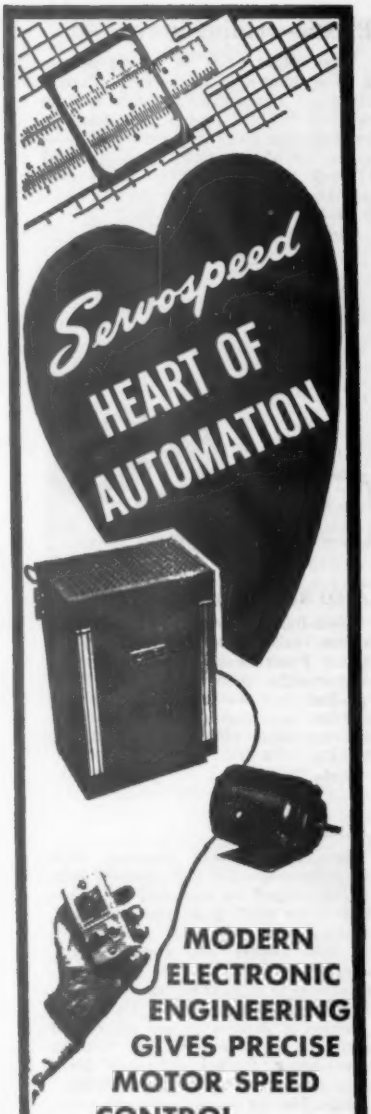
Circle No. 17



Time-study recorder

Recording instrument provides time-study data on any electric welding operation. Designed to provide data on any type job from large or small production work to maintenance and repairs, instruments are equipped with time-printed chart rolls feeding continuously while ballpoint stylus draws graph lines. Lines show on and off time recorded. Time totalizer accumulates readings from tape and shows total productive time to 1/10 of a minute for any period. *Weld-Record Corp.*

Circle No. 18



MODERN ELECTRONIC ENGINEERING GIVES PRECISE MOTOR SPEED CONTROL

1/100 — 10 H. P.

Modern industrial electronic engineering has been coordinated with electric motor design to provide a versatile means for obtaining the full possible advantage of speed control in DC motors while operated from the regular alternating current power line. Grid controlled "Thyratron" tubes are utilized for power controlled stepless variation to supply motor armature power. Patented feedback, or "Servo" circuits provide constant torque capability over wide speed ranges of as high as 60 to 1 in some models and a minimum of 20 to 1 in others.

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DIV. of ELECTRO DEVICES, Inc.
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ARmory 4-8989

Circle No. 195 on Reader Service Card

Voltage converter

Unit can provide 110-volt a-c from 12-volt storage battery. Unit can be used to operate electric power tools. Available in four models with 150 to 500 watts output, unit becomes fast or slow charger for 6 to 12-volt batteries. *The Electric Storage Battery Co.*

Circle No. 19

Gas cylinder cart

Gas cylinder cart eliminates danger of dropping inherent in two-wheel carts. Fire wall between oxygen and fuel gas cylinders gives added protection. Cart pulled from front has low center of gravity to prevent tipping. Cart provides space for tools, welding rods and hose. Features include zero pressure tines and anti-friction bearings. *Smith-Byrd Co., Inc.*

Circle No. 20

Induction heaters

Automatic induction heating soldering unit is designed for high-speed precision part heating which previously could not be soldered. Unit can solder miniature components, usually sensitive to heat, in few seconds with little or no flux and precise heating. Unit feature: electronic timer and contractor built-in for soldering miniature component (accurate to 1/100 second). Unit has automatic fluxer, energy transfer applicator for precision heating and automatic or semi-automatically operated indexing turntable. *Reeve Electronics Inc.*

Circle No. 21

—your LINDE distributor!

These days, more and more developments in welding hold the solution to knotty metalworking problems. The efficiency, economy, and versatility of modern welding methods and equipment are benefits which you should know about when joining or cutting metals.

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Prove it to yourself—call your nearby LINDE distributor. He's in the classified directory. He is as close as your telephone. Or, write for his address to Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. *In Canada:* Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

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For more facts Circle No. 196 on Reader Service Card

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ACRO-ARC® special purpose production welding machinery employing automatic arc welding processes.

ACROMATIC® special purpose production welding machinery employing resistance welding processes.

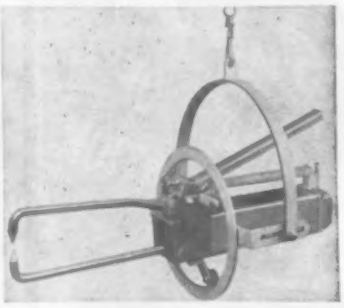
ACRO-MAGNETIC® magnetic force spot, projection, and percussion welding machines.

For more facts Circle No. 197 on Reader Service Card

Plastic-welding torch

Lightweight torch for joining plastics is 11-in. long and weighs 9 oz. Combination of five interchangeable heating elements enables proper unit selection for particular welding requirements. Designed to plug directly into standard 115-volt power and 100-psi compressed air lines, unit has heat range to 700 F. *D. & R. Plastic Welders, Inc.*

Circle No. 22



Gyro attachment

"Gyro-Bail" attached to firm's spot welders takes weight off operator's hands. Functioning from boom and counterweight or spring-loaded cable, Gyro-Bail spot welder instantly adjusts itself for any approach angle and use with minimum effort. *Miller Electric Mfg. Co.*

Circle No. 23

Oxide remover

Chemical weld-area cleaning compound removes oxide films without pickling. Developed for removing chromium oxide "heat tint" from stainless steel, compound also effectively removes oxides from copper and copper alloys. Paste, applied only to area needing it, will adhere to vertical surfaces or underside of horizontal surfaces. Compound is painted or daubed on and allowed to remain for an average of two minutes before being flushed off with plain water. *Eutectic Welding Alloys Corp.*

Circle No. 24

Internal seam welder

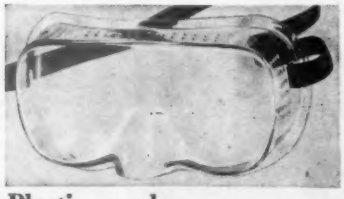
Designed for internal girth welding seams in rocket shells, unit uses both Mig and Tig. Unit is equipped with cross-slide and two cathead assemblies so two different diameter shells can be welded without changing tooling. Tooling consists of external copper closing rings machined at 600 F to ±0.005-in. tolerance. Welding head assembly is mounted on pivoted slide so unit can go through 24-in. opening and still reach 6-ft-diameter tank or shell bottom. Machine is 60-ft long, 14-ft high, 23-ft wide and weighs 54 tons. *Berkeley-Davis Inc.*

Circle No. 25

A-c/d-c welders

Two all-purpose a-c/d-c inert-gas-shielded-arc welders can weld with as little as 1-amp current. Model ADI-2641, rated 200 amp, has 1 to 300 amp a-c or 1 to 350 amp d-c welding range. Model ADI-3641, rated 300 amp, has welding range of 1 to 375 amp a-c or 1 to 410 amp d-c. Hinged top permits easy access to spark gap and high-frequency-stabilizer timers. Features include permanent cables, automatic contactor, remote control hand switch. Both are designed to operate from single-phase 230/460 a-c power. *Hobart Bros. Co.*

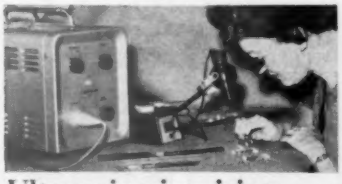
Circle No. 26



Plastic goggles

E-7C goggles of 0.053 clear plastic will fit over corrective eyeglasses. Impact resistant goggles meet government specifications. Model E-8G is green. Both models are free from visible defects and distortion. *Eastern Safety Equipment Co., Inc.*

Circle No. 27

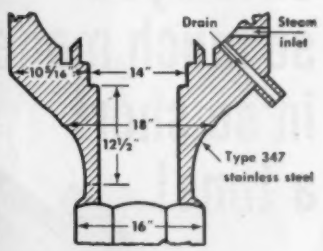


Ultrasonic micro-joiner

Unit can handle ultrasonic micro-joining including heatless welding and fluxless soldering. Unit will weld leads as fine as 0.0001-in. diameter. Unit consists of ultrasonic transducer hand piece and four basic inserts with additional tips to be added. Unit can weld gold wire as fine as 0.0004-in. diameter, CP nickel 0.002-in. diameter leads, solder gold wire on gold plated silicon and on 0.003-in. aluminum foil. *Cavitron Corp.*

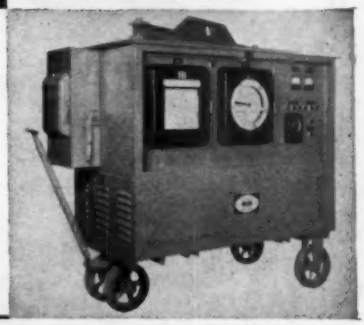
Circle No. 28

Profit through E.A.I. Research



Uniform, through-and-through heating of the thickest sections of the big stainless steel valves was provided by the Smith-Dolan method, with precision control of temperatures (2-hour dwell at 1900°F.). Drawing shows cross-sectional dimensions.

Standard Smith-Dolan units come equipped with eye hooks and wheels for easy portability, and with instrumentation for recording permanent charts of the heat run.



SMITH-DOLAN On-the-Job HEAT TREATMENT

Solution to Weld Embrittlement Problem at Consolidated Edison

Public utilities are among the largest users of the Smith-Dolan System of Low-Frequency Induction Heating. They want to keep their service uninterrupted, their costs low, and they find that this portable system simplifies the problem of pre-heating and post-annealing in producing sound welds, and in making dependable repairs.

A typical application of the system by a public utility was described in a recent article in Welding Design & Fabrication.* At Consolidated Edison's No. 10 Turbine Generating Station in New York City, two large steam pressure valves made of Type 347 stainless had to be repaired because of weld embrittlement. Removal to the shop for heat treatment would have proved costly and time taking. With the Smith-Dolan portable units, the work was completed on the job within 12 hours.

Learn about the savings and other benefits your company can obtain from the Smith-Dolan System. It is today's most versatile heat treating method, simplifies and upgrades work quality in numerous applications. Write for brochure, "Smith-Dolan System of Low-Frequency Induction Heating."

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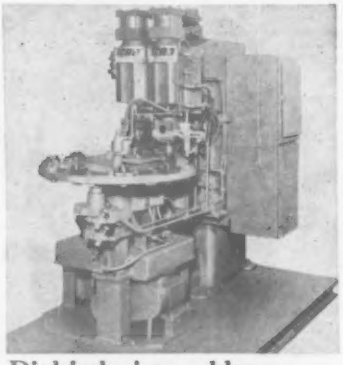
Pipe bender

Model No. 2 hand-operated portable ram bender is designed to bend steam and gas pipes (to 2-in. extra heavy pipe) or heavy wall tubes. Bender has full power return. It develops 8 tons thrust at 6,000 psi. Open-type wingheads provide full visibility bending, freedom from obstructions, speedier handling and easy access for cleaning and maintenance. Standard tools include ⅜ in., ½ in., 1 in., 1¼ in., 1½ in. and 2 in. Also available with tube and flat bar dies. Net weight, including case, is 135 lb. *Wallace Supplies Mfg. Co.*

Circle No. 29



Dial-indexing welder

Dial-indexing welder has two 75-kva 2,300-lb electrode force-press welding heads for joining wheel assemblies. Unit has three-hopper orienting bowl and track transfer assemblies for automatic loading. Unit produces ball bearing conveyor wheel assemblies. *Acro Welder Mfg. Co.*

Circle No. 30

Safety spectacles

Safety spectacles feature temples with 3-D appearance. Each temple offers over 2-sq-in. bearing surface to assure better fit. New temple screw is sealed in and will never loosen or back out, yet can be easily removed and replaced without special tools. Two-tone and solid colors, cup or flatfold sideshields are available. *U.S. Safety Service Co.*

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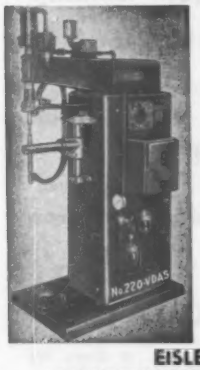

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Charles Eisler Jr.,President
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Book Reviews

Metallizing symbols

AMERICAN STANDARD METALLIZING SYMBOLS. Published by The American Society of Mechanical Engineers in collaboration with the AWS, 1960. Price $1.

The standard, based on symbols used in the U.S. and Canada, provides a means for conveying information from design office to shop or between distant locations with assurance that specified requirements will be met.

Information is divided into four main sections: basic symbols surface preparation symbols supplementary symbols and applications.

Explosive forging

THE EXPLOSIVE WORKING OF METALS. Published by Office of Technical Services, U. S. Department of Commerce. By J. Pearson, 1960, 48 pages. Price $1.50.

This report claims that the most promising future for explosive forging lies in extending it to new and different operations now beyond the scope of conventional equipment rather than duplicating the results of conventional methods.

First presented as a research paper at the "Symposium on processing materials for re-entry structures" in 1960, the report relates current operations in explosive forging to some fundamental aspects of forces, pressures, velocities, and other factors.

Welding, parts forming, sizing, shaping, compacting, and other metalworking operations performed by energy released from either a detonating or deflagrating explosive are also discussed.

Metallizing shafts

RECOMMENDED PRACTICE FOR METALLIZING SHAFTS OR SIMILAR OBJECTS. Published by American Welding Society, New York City, 1960, 32 pages. Price $1.

This new revision is illustrated with diagrams, line drawings and halftones and a new section has been introduced on surface preparation for metallizing.

Most of the material has been rewritten to bring it up-to-date and the contents have been rearranged for quicker reference. Material has been divided into: general, surface preparation, spraying and finishing.

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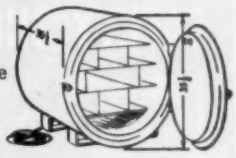

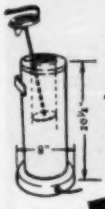

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Free Literature

. . . use card on p. 85

75. HARDFACING — Wall Colmonoy Corp. Alloy News Vol. 5 No. 5 in two colors tells how hardfacing cuts replacement costs, gives longer service life.

76. A-C VOLTMETERS — General Electric Co. Bulletin GEZ-3109, four pages, describes firm's new line of a-c voltmeters and ammeters.

77. POSITIONING EQUIPMENT — Ransome Co. 16-page guide (59-A-296) gives basic reasons for using positioning equipment, describes available equipment and explains ratings.

78. STRIP JOINING — The Taylor-Winfield Corp. Weld-It No. 603, four pages, two colors, describes and illustrates strip joining with spot and seam welders.

79. WELDING SCHOOL — The Lincoln Electric Co. Bulletin AV-111 outlines the program in arc welding education available at the firm's school.

80. LP-GAS CUTTING — Smith Welding Equipment Corp. Dial-a-tip rotating pocket dial (Form No. DAT-P) lists firm's tip number for various LP-Gas cutting purposes.

81. ALUMINUM DIP-BRAZING — John Gombos Co., Inc. Four-page two-color brochure describes aluminum dip brazing process.

82. CRYOGENIC COUPLING — The Cosmodyne Corp. Data sheet describes and illustrates firm's army ordnance design cryogenic coupling.

83. BELT GRINDING — The Nedco Co. Sheet describes and illustrates attachment for transforming any portable grinder into dual purpose grinder.

84. RECTIFIER TUBE — National Electronics, Inc. Sheet describes 10-amp d-c rectifier tube.

85. ULTRASONIC TESTING — Sperry Products Co. 12-page Nondestructive Testing Bulletin 00-105 describes ultrasonic testing equipment line.

86. ALKALINE CLEANER — Oakite Products, Inc. Service Bulletin No. 17B describes strongly alkaline cleaner (used with all metals but aluminum and zinc).

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WELDING SPECIALIST

Practical, competent Welding Specialist with minimum of 10 years experience in fusion welding. Prefer man who has been a welder with experience in welding development work.

Job will be concerned with fusion welding including normal metallic arc, automatic and semi-automatic submerged arc, Tungsten inert gas, C.O., and Heliarc welding. Materials include mild steels, low alloys, stainless steels and aluminum. Products are mid-range in size with majority ranging from 5 to 500 pounds.

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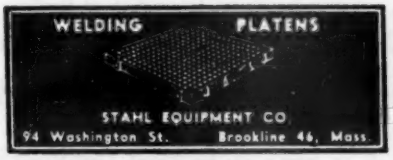

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87. WELDING ELECTRODES — The McKay Co. Illustrated 8-page Insert Bulletin A-3 contains case history reports on successful use of welding electrodes in three varied industries.

88. X-RAY INSPECTION — Industrial X-Ray, Inc. Booklet explains, illustrates and describes x-ray inspection.

89. WELDING MACHINES — Morton Mfg. Co. Bulletin No. 44R lists and illustrates firm's line of stake welding machines.

90. FLEXIBLE HOSE — The Flexaust Co. Bulletin 605, 12 pages in color, gives installation information on flexible hoses.

91. ALLOY STEEL WELDING — Esco Corp. Catalog No. 175 DS, 24 pages in color, describes firm's services, welding fabrication and casting methods.

92. WELDING TORCHES — Linde Co. Form 55-005, eight pages and two colors, describes Oxweld W-45 and W-47 welding torches.

93. WELDING RODS — The Chicago Hardware Foundry Co. Forms 1500, 1500A, 1500B give prices and specifications of welding rods and cylinder wrenches.

94. DIE ALLOY — Ampco Metal, Inc., Bulletin G-55 describes new hard bronze die alloy for drawing, forming and bending stainless and clean mild steels.

95. HYDRAULIC WELDING CLAMP — Blackhawk Industrial Div. Illustrated booklet describes hydraulic welding clamping tool.

96. GAGES, FITTING — Oxo Welding Equipment Co. Eight-page illustrated booklet gives prices and specifications of firm's fittings, gages.

97. ELECTRONIC WELDING EQUIPMENT — Hughes Aircraft Co. Illustrated, color Short Form Catalog describes line of electronic equipment for welding small parts and thin metals.

98. HOLE CUTTER — Steffan Mfg. Corp. Form No. UHC 1060 describes automatic hole cutters.

99. TIG TORCH — Falstrom Co. Bulletin WC-60, illustrated, color, describes a controlled-angle Tig torch.

100. ALLOY STEELS — Jones & Laughlin Corp. Multi-color, illustrated brochure (AD 287) describes Jalloy-S constructional steels.

101. OXYGEN PURITY RECORDER — Thermco Instrument Corp. Illustrated Bulletin 101-107 describes oxygen purity recorder for air rectifying column.

102. ORNAMENTAL METALS — Tennessee Fabricating Co. Form No. 1983.0, illustrated and in color, gives decorating possibilities and explains installation of aluminum design units.

103. NUCLEAR X-RAY — Philips Electronic Instruments Div. Four-page folder, illustrated, discusses nuclear problems handled with x-rays.

104. PLASTIC PRODUCTION — American Agile Corp. Four-page booklet describes Thermofusion method for making large plastic products.

105. BENCH WELDERS — The Federal Machine & Welder Co. Bulletin BA-60, in color, illustrates and describes firm's line of bench welders in capacities from 5 to 50 kva.

106. MULTI-ARC WELDING — J. B. Nottingham & Co. four-page bulletin describes multi-operator resistor units for individual control of welding arcs in multi-arc systems.

107. RECTIFIERS — Syntron Co. Eight-page Catalog No. 100, illustrated in color, describes complete line of certified silicon and selenium rectifiers.

108. MIDGET AIR CYLINDER — Hannifin Co. Bulletin 0230-B1 provides concise engineering data and specifications on new maximum 200 psi Series "S" midget air cylinder.

109. OXYGEN CUTTING—Air Reduction Sales Co. Form ADR 127 is article on specific problems associated with oxygen cutting of bevels.

110. X-RAY UNIT — General Electric Co. Product Data Sheet A4605 describes Resotron 2000 industrial x-ray unit.

111. DIAL FEED WELDER — Raytheon Co. Product Data 2-272 illustrates and gives features, description and specifications of continuous-dial feed welder.

112. MIG, TIG TORCH — National Cylinder Gas Div. Bulletin NH 142 describes NCG A-10 automatic torch for Mig and Tig welding and AM-7 gun for semiautomatic welding.

113. SADDLE FITTINGS — Allied Piping Products Co., Inc. Form 5-60 illustrates and gives specifications of saddle fittings.

114. PIPE THAWING — Hobart Bros. Co. Bulletin EW-243 gives data on thawing frozen water pipes with low-voltage electricity.

115. LIQUID GAS CONTAINERS — The International Nickel Co., Inc. 27-page booklet is aid to selecting materials for cryogenic service.

116. LOCATING PLANS — Turco Products, Inc. Four-page pamphlet describes 23-minute 16-mm sound and color film on dye penetrant inspection methods.

117. X-RAY INSPECTION — Balteau Electric Corp. Technical Bulletin No. 5 is two-page illustrated folder on x-ray equipment application in inspection of fuel oil heater elements.

118. RESISTANCE WELDERS — Thomson Electric Welder Co. Bulletin 4-0-01, illustrated four pages, describes air-operated bench-type spot and projection resistance welders.

119. NON-DESTRUCTIVE TESTING — Elion Ultrasonics, Inc. Form 13-502M, illustrated and in color, lists firms ultrasonic systems, transducers and other equipment for non-destructive testing.

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Advertisers' Literature

Literature offered in advertisements which were received up to the 5th of last month. To get the literature you want circle numbers on Reader Srvice Card on this page.

180. All-State Welding Alloys Co., Inc. — "All-State Instruction Manual and Catalog" available.

163. American Platinum & Silver Div. — "A Complete Guide To Selective Fluxing For Low Temperature Silver Brazing" is available.

157. Ampco Metal, Inc. — Bulletin W-17 gives detailed facts on the complete Ampco welding line.

200. Anti-Borax Compound Co., Inc. — Descriptive circular and free sample of brazing flux available.

159. The Bastian-Blessing Co. — Booklet available, "RegO Manifold Reference and Planning Brochure" explains how manifolds work.

196. Becker Brothers Carbon Co. — Catalog available on carbon and graphite for welding electrodes, rods and other materials used in welding.

153. Bernard Welding Equipment Co. — Bulletin SS7, describing the features of the "Shortstub" electrode holder.

178. Cam-Lok Div. — Catalog available on plugs, connectors and receptacles, manufactured by Cam-Lok.

201. Coast Metals, Inc. — Loose leaf binder contains latest information and technical data on the Coast Metals line of arc and gas welding rods, automatic wire and castings for critical parts.

192. Columbia Electric Mfg. Co. — Catalog WE-400 is available on the Tong-Test Ammeter to get the exact amperage for your welding job.

203. Eisler Engineering Co., Inc. — Catalog No. 93-57 available on spot and wire butt welders and the vertical type press welder.

198. Electric Arc, Inc. — Write for brochure "Smith-Dolan System of Low-Frequency Induction Heating."

174. The Gevaert Co. of America, Inc. — Write for a handy exposure calculator for either Ir 192 or Co 60 radiography of steel.

151. Hobart Brothers Co. — Write for bulletin DM-101 on the Hobart DC motor generator welder.

181. Invincible Vacuum Cleaner Mfg. Co. — Write for folder on Invincible Flux Recovery System.

173. Markal Company — Send for the new Markal "Thermomelt" brochure and sample pellets.

191. Merrill Brothers. — Catalog C-2 available on the "Twin-Lifter" and other material handling devices.

205. Metalloy Products Co. — Write for a testing sample of "Galvalloy" for your galvanizing job.

182. National Cylinder Gas Div. of Chemetron Corp. — Bulletin NH-142-E-2-B gives further information on the NCG AM-7 Gun for MIG welling.

175. Page Steel & Wire Div. — Booklet available on Page automatic welding wire.

204. Phoenix Products Co. — Folder available, "Dry Rod as Standard Welding Equipment", gives additional information on Phoenix "DryRod" electrode ovens.

170. Ransome Company — For further information on positioning equipment write for the Ransome catalog and "Guide to Positioning Equipment."

169. A. O. Smith Corp. — Bulletin MW-253 further explains the Button Weld made with "C-Omanual."

162. Tuffaloy, Air Reduction Sales Co. — Catalog available on Tuffaloy bent tips.

209. Tweco Products, Inc. — Catalog available on Tweco ground clamps and the complete line of Tweco accessories.

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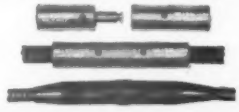

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